Troubleshooting Guide

HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software

Product Version: 8.8-1

Third Edition (March 2005)

Part Number: EK-G80TS-SA.C01

This guide provides troubleshooting instructions for HSG60 and HSG80 array controllers running Array Controller Software (ACS) Versions 8.8L, 8.8F, 8.8G, 8.8P, and 8.8S. This guide contains information on various utilities, software templates, and event reporting codes.

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contents

About this Guide . . . 11
Overview . . . 11
Intended audience . . . 12
Prerequisites . . . 12
Related documentation . . . 12
Conventions . . . 15
Document conventions . . . 15
Text symbols . . . 15
Equipment symbols . . . 16
Rack stability . . . 17
Getting help . . . 18
HP technical support . . . 18
HP storage website . . . 18
HP authorized reseller . . . 18

1 Troubleshooting Information . . . 19
Typical installation problem identification checklist and troubleshooting guidelines . . . 20
Significant event reporting . . . 31
Reporting events that cause controller operation to halt . . . 31
Flashing OCP pattern display reporting . . . 32
Solid OCP pattern display reporting . . . 34
Last failure reporting . . . 39
Reporting events that allow controller operation to continue . . . 40
Spontaneous Event log . . . 40
CLI Event reporting . . . 41
Running the controller diagnostic test . . . 41
ECB charging diagnostics . . . 42
Battery hysteresis . . . 42
UPS used for backup power . . . 43

Caching techniques 44
Read caching 44
Read-ahead caching 44
Write-through caching 45
Writeback caching 45
Fault-tolerance for writeback caching 45
Nonvolatile memory 46
Cache policies resulting from cache module failures 47
Dual external cache battery failures 53
Enabling mirrored writeback cache 53
Device Discovery Error report 53
`SHOW ELEVATION` report 56

2 Utilities and Exercisers 67
Fault Management Utility (FMU) *68*
Displaying last failure entries. 68
Translating event codes 70
Controlling the display of significant events and failures 71
`SHOW LAST` *`ALL`* command. 74
`SHOW RESERVATION` command. 75
Command variants 75
`CLEAR RESERVATION` command 77
Device Information and Error Utilities 78
`SHOW DEVICE_INFORMATION` command 78
. . . . 80
`SHOW DEVICE_ERRORS` and `CLEAR DEVICE_ERRORS unit` command . . 84
SHOW DEVICE_ERRORS command 84
Interpreting Event log fields 85
Common event descriptions 87
`CLEAR DEVICE_ERRORS` unit command 88
Video Terminal Display (VTDPY) utility 89
VTDPY Restrictions 89
Running *VTDPY*. *89*
VTDPY help 91
VTDPY screens. 92
Display Default screen. 92
Controller Status screen. 93
Cache Performance screen. 95
Device Performance screen 96

Host Ports Statistics screen 98
Resource Statistics screen 100
Remote Status screen. 102
Interpreting *VTDPY* screen information. 102
Screen header. 103
Common data fields. 104
Unit Performance data fields 105
Device Performance data fields. 108
Device Port Performance data fields 109
Host port configuration 110
TACHYON chip status 112
Runtime Status of Remote Copy Sets screen 113
Device port configuration 114
Controller and processor utilization 115
Resource performance statistics 117
Disk Inline Exerciser (DILX) *119*
Checking for unit problems 119
Finding a unit in the subsystem. 119
Testing the read capability of a unit 119
Testing the read and write capabilities of a unit 121
DILX error codes 124
Format and device code load utility (HSUTIL) *126*
Configuration (CONFIG) utility. 128
Code Load and Code Patch (CLCP) utility 129
CLONE utility. 131
Field Replacement Utility (FRUTIL) *132*
Change Volume Serial Number (CHVSN) utility 133

3 Event Reporting Templates. 135
Passthrough Device Reset Event Sense Data Response template 137
Last Failure Event Sense Data Response template (Template 01). 138
Multiple-Bus Failover Event Sense Data Response template (Template 04). 140
Failover Event Sense Data Response template (Template 05). 142
Device Discovery Error Sense Data Response template (Template 06) 144
Nonvolatile Parameter Memory Component Event Sense Data Response template (Template 11) 145
Backup Battery Failure Event Sense Data Response template (Template 12). 147
Subsystem Built-In Self-Test Failure Event Sense Data Response template (Template 13) 149
Memory System Failure Event Sense Data Response template (Template 14) 151

Device Services Nontransfer Error Event Sense Data Response template (Template 41). . 153
Disk Transfer Error Event Sense Data Response template (Template 51). 155
Data Replication Manager Services Event Sense Response template (Template 90) 157
Connection Table Full Event Error template (Template A0) 159

4 ASC, ASCQ, Repair Action, and Component Identifier Codes 161
Vendor-specific SCSI ASC and ASCQ codes 162
Recommended Repair Action Codes 167
Component ID Codes 175

5 Instance Codes 177
Instance Code structure. 178
Instance Code format 179
Notification and recovery threshold. 179
Repair action 180
Event number 180
Component ID 180

6 Last Failure Codes 211
Last Failure Code structure. 212
Last Failure Code format 213
Parameter Count. 213
Restart Code. 213
Hardware and software flag 214
Repair Action Code 214
Error Number 214
Component ID Code 214
Last Failure and Repair Action Codes 214

7 Alternative Controller Operations 269
Handling host-configured units in error 270
Setting SCSI Fairness 272

Glossary. 275

Index 303

Figures

1 OCP pattern display showing %FLL formatting 34
2 Sample Last Failure report 39
3 Sample Spontaneous Event logs showing %EVL formatting 40
4 Sample CLI Event report showing %CER formatting 41
5 SHOW THIS CLI sample screen display 43
6 Sample Device Discovery Error Report 54
7 Sample last failure entry 69
8 FMU translation of a Last Failure Code and an Instance Code Sample 71
9 `SHOW RESERVATION` sample output (Microsoft® Windows® 2003 32-bit) 76
10 `SHOW RESERVATION` Sample Output (HP Tru64 UNIX) 77
11 `SHOW DEVICE_INFO D`*`xxxx`* sample output 78
12 `SHOW DEVICE_INFO` *`ALL`* sample output 79
13 `SHOW DEVICE_ERRORS` sample output 84
14 Event log interpretation 85
15 *VTDPY* commands and shortcuts generated from the HELP command 91
16 Sample of the *VTDPY* default screen 93
17 Sample of the Controller Status screen 94
18 Sample of the Cache Performance screen 95
19 Sample of regions on the Device Performance screen 97
20 Sample of the Host Ports Statistics screen 99
21 Sample of the *VTDPY* Resource Statistics screen 101
22 Sample of the *VTDPY* Remote Status screen (ACS V8.8P only) 102
23 Sample port configuration information 114
24 Example of a listing of patches with associated checksum values 129
25 Structure of an Instance Code 178
26 Structure of a Last Failure Code 212

Tables

1 Related Documentation 12
2 Document Conventions 15
3 Installation Problem Identification Checklist 20
4 Troubleshooting Guidelines 22
5 Flashing OCP Pattern Displays and Repair Actions 32
6 Solid OCP Pattern Displays and Repair Actions 35
7 ECB Capacity Based on Memory Size 42
8 Cache Policies—Cache Module Status 47
9 Resulting Cache Policies—ECB Status 50

10 DWD Status Codes 54
11 EC Codes 56
12 Event Code Types 70
13 *FMU* SET Commands 72
14 Disk Device Information 80
15 Event log interpretation legend 86
16 Common Event Descriptions 87
17 *VTDPY* Key Sequences and Commands 90
18 *VTDPY*—Common Data Fields Column Definitions: Part 1 104
19 *VTDPY*—Common Data Fields Column Definitions: Part 2 105
20 *VTDPY*—Unit Performance Data Fields Column Definitions 106
21 *VTDPY*—Device Performance Data Fields Column Definitions 108
22 *VTDPY*—Device Port Performance Data Fields Column Definitions 109
23 Fibre Channel Host Status Display—Known Host Connections 110
24 Fibre Channel Host Status Display—Port Status 110
25 Fibre Channel Host Status Display—Link Error Counters 111
26 First Digit on the TACHYON Chip 112
27 Second Digit on the TACHYON Chip 112
28 Remote Display Column Definitions—ACS P Variant Only 113
29 Device Map Column Definitions 115
30 Controller and Processor Utilization Definitions 115
31 *VTDPY* Thread Descriptions 116
32 Resource Performance Statistics Definitions 117
33 *DILX* Control Sequences 120
34 Data Patterns for Phase 1: Write Test 121
35 *DILX* Error Codes 124
36 *HSUTIL* Messages and Inquiries 126
37 Passthrough Device Reset Event Sense Data Response Format 137
38 Template 01—Last Failure Event Sense Data Response Format 138
39 Template 04—Multiple-Bus Failover Event Sense Data Response Format 140
40 Template 05—Failover Event Sense Data Response Format 142
41 Template 11—Nonvolatile Parameter Memory Component Event Sense Data
Response Format 145
42 Template 12—Backup Battery Failure Event Sense Data Response Format 147
43 Template 13—Subsystem Built-In Self Test Failure Event Sense Data Response
Format 149
44 Template 14—Memory System Failure Event Sense Data Response format 151

45 Template 41—Device Services Non-Transfer Error Event Sense Data Response Format 153
46 Template 51—Disk Transfer Error Event Sense Data Response Format 155
47 Template 90—Data Replication Manager Services Event Sense Data Response Format for ACS V8.8-xP Only 157
48 ASC and ASCQ Code Descriptions 162
49 Recommended Repair Action Codes 167
50 Component ID Codes 175
51 Instance Code Format 179
52 Event Notification and Recovery (NR) Threshold Classifications 179
53 Instance Codes and Repair Action Codes 181
54 Last Failure Code Format 213
55 Controller Restart Codes 213
56 Last Failure Codes and Repair Action Codes 214

about this guide

This troubleshooting guide provides information to help you troubleshoot problems with HP StorageWorks HSG60 and HSG80 array controllers.

"About this Guide" topics include:

- Overview, page 11
- Conventions, page 15
- Rack stability, page 17
- Getting help, page 18

Overview

This section covers the following topics:

- Intended audience
- Prerequisites
- Related documentation

Intended audience

This document for users who are experienced with the following:

- HSG60 and HSG80 array controllers
- HP StorageWorks Array Controller Software (ACS)
- HP StorageWorks BA370 enclosure and enclosure components
- HP StorageWorks M2100 and M2200 enclosures and enclosure components

Prerequisites

Before you complete procedures in this document, consider the following items:

- Know what version of ACS is currently in use.
- Know which enclosure model is currently in use.
- Determine whether the subsystem controllers are in a single or dual-redundant configuration.
- Familiarize yourself with your specific subsystem configuration details.
- Determine the model and types of components installed in your enclosure. The procedures in this document are specific to HSG60 and HSG80 array controllers in a BA370, Model 2100, and Model 2200 enclosures.

Related documentation

Other related documentation is listed in Table 1. To acquire up-to-date information regarding the HSG60 and HSG80 array controllers or ACS, visit the following HP website:

- http://h18006.www1.hp.com/products/storageworks/acs/index.html

Table 1: Related Documentation

Item	Document Name	Document Part Number
1.	*Compaq StorageWorks Modular Array Configuration Guide*	EK-MACON-CA
2.	*HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Troubleshooting Guide*	EK-G80TS-SA. C01
3.	*HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Maintenance and Service Guide*	EK-G80MS-RA. C01

Table 1: Related Documentation (Continued)

Item	Document Name	Document Part Number
4.	*HP StorageWorks Replacing a Gigabit Link Module (GLM) in an HSG60 or HSG80 Array Controller Installation Instructions*	EK-80GLM-TE. D01
5.	*HP StorageWorks Replacing DIMMs in an HSG60 or HSG80 Cache Module Installation Instructions*	EK-80DIM-IM. E01
6.	*HP StorageWorks Replacing an HSG60 or HSG80 Cache Module Installation Instructions*	EK-80CAH-IM. F01
7.	*HP StorageWorks Replacing an HSG60 or HSG80 Array Controller Installation Instructions*	EK-80CTL-IM. F01
8.	*HP StorageWorks Replacing an External Cache Battery (ECB) Installation Instructions*	EK-80ECB-IM. F01
9.	*HP StorageWorks HSG80 ACS Solution Software Version 8.8 for HP-UX Installation and Configuration Guide*	AA-RV1FA-TE
10.	*HP StorageWorks HSG80 Enterprise/Modular Storage RAID Array Fibre Channel Solution Software Version 8.8 for HP-UX Release Notes*	AA-RV1GA-TE
11.	*HP StorageWorks HSG80 ACS Solution Software Version 8.8 for IBM AIX Installation and Configuration Guide*	AA-RV1HA-TE
12.	*HP StorageWorks HSG80 Enterprise/Modular Storage RAID Array Fibre Channel Solution Software Version 8.8 for IBM AIX Release Notes*	AA-RV1JA-TE
13.	*HP StorageWorks HSG80 Enterprise/Modular Storage RAID Array Fibre Channel Solution Software Version 8.8 for Linux X86 and Alpha Release Notes*	AA-RV1KA-TE
14.	*HP StorageWorks HSG80 ACS Solution Software Version 8.8 for LINUX X86 and Alpha Installation and Configuration Guide*	AA-RV1LA-TE
15.	*HP StorageWorks HSG80 ACS Solution Software Version 8.8 for Novell NetWare Installation and Configuration Guide*	AA- RV1MA -TE
16.	*HP StorageWorks HSG80 Enterprise/Modular Storage RAID Array Fibre Channel Solution Software Version 8.8 for Novell NetWare Release Notes*	AA- RV1NA -TE
17.	*HP StorageWorks HSG80 ACS Solution Software Version 8.8 for OpenVMS Installation and Configuration Guide*	AA- RV1PA -TE
18.	*HP StorageWorks HSG80 Enterprise/Modular Storage RAID Array Fibre Channel Solution Software Version 8.8 for OpenVMS Release Notes*	AA- RV1QA -TE

Table 1: Related Documentation (Continued)

Item	Document Name	Document Part Number
19.	*HP StorageWorks HSG80 ACS Solution Software Version 8.8 for Sun Solaris Installation and Configuration Guide*	AA- RV1RA -TE
20.	*HP StorageWorks HSG80 Enterprise/Modular Storage RAID Array Fibre Channel Solution Software Version 8.8 for Sun Solaris Release Notes*	AA- RV1SA -TE
21.	*HP StorageWorks Command Console Version 2.4 Release Notes*	AV- RV1TA -TE
22.	*HP StorageWorks Command Console Version 2.4 User Guide*	AA- RV1UA -TE
23.	*HP StorageWorks Command Console Version 2.4 Online Help* (HSG60 and HSG80)	AA-RS20A-TE AA-RS21A-TE
24.	*HP StorageWorks HSG80 ACS Solution Software Version 8.8 for Tru64 UNIX Installation and Configuration Guide*	AA- RV1VA -TE
25.	*HP StorageWorks HSG80 Enterprise/Modular Storage RAID Array Fibre Channel Solution Software Version 8.8 for Tru64 UNIX Release Notes*	AA- RV1WA -TE
26.	*Compaq StorageWorks 64-Bit PCI-to-Fibre Channel Host Bus Adapter User Guide*	AA-RKPDB-TE
27.	*Digital StorageWorks UltraSCSI RAID Enclosure (DS-BA370-Series) User's Guide*	EK-BA370-UG. B01
28.	*HP StorageWorks HSG80 ACS Solution Software Version 8.8 for Windows Installation and Configuration Guide*	AA- RV1XA -TE
29.	*HP StorageWorks HSG80 ACS Solution Software Version 8.8 for Windows Release Notes*	AA-RV1YA-TE
30.	*HP StorageWorks Enterprise/Modular Storage RAID Array Fibre Channel Arbitrated Loop Configurations Application Note*	AA-RS1ZB-TE
31.	*HP StorageWorks Enterprise/Modular Storage RAID Array Fibre Channel Arbitrated Loop Configurations for Novell Netware Application Note*	AA-RVHHA-TE
32.	*HP StorageWorks Addendum for ACS Solution Software - Differences Between HSG60 and HSG80 Array Controllers*	AV-RV2MA-TE

Conventions

Conventions consist of the following:

- Document conventions
- Text symbols
- Equipment symbols

Document conventions

This document follows the conventions in Table 2.

Table 2: Document Conventions

Convention	Element
Blue text: Figure 1	Cross-reference links
Bold	Menu items, buttons, keys, tabs, and box names
Italics	Text emphasis and document titles in body text
`Monospace font`	User input, commands, code, file and directory names, and system responses (output and messages)
`Monospace, italic font`	Command-line and code variables
Blue underlined sans serif font text (http://www.hp.com)	Website addresses

Text symbols

The following symbols may be found in the text of this guide. They have the following meanings:

WARNING: Text set off in this manner indicates that failure to follow directions in the warning could result in bodily harm or death.

Caution: Text set off in this manner indicates that failure to follow directions could result in damage to equipment or data.

Tip: Text in a tip provides additional help to readers by providing nonessential or optional techniques, procedures, or shortcuts.

Note: Text set off in this manner presents commentary, sidelights, or interesting points of information.

Equipment symbols

The following equipment symbols may be found on hardware for which this guide pertains. They have the following meanings:

Any enclosed surface or area of the equipment marked with these symbols indicates the presence of electrical shock hazards. Enclosed area contains no operator serviceable parts.

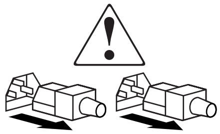
WARNING: To reduce the risk of personal injury from electrical shock hazards, do not open this enclosure.

Any RJ-45 receptacle marked with these symbols indicates a network interface connection.

WARNING: To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.

Any surface or area of the equipment marked with these symbols indicates the presence of a hot surface or hot component. Contact with this surface could result in injury.

WARNING: To reduce the risk of personal injury from a hot component, allow the surface to cool before touching.



Power supplies or systems marked with these symbols indicate the presence of multiple sources of power.

WARNING: To reduce the risk of personal injury from electrical shock, remove all power cords to completely disconnect power from the power supplies and systems.

Any product or assembly marked with these symbols indicates that the component exceeds the recommended weight for one individual to handle safely.

WARNING: To reduce the risk of personal injury or damage to the equipment, observe local occupational health and safety requirements and guidelines for manually handling material.

Rack stability

Rack stability protects personnel and equipment.

WARNING: To reduce the risk of personal injury or damage to the equipment, be sure that:

- The leveling jacks are extended to the floor.
- The full weight of the rack rests on the leveling jacks.
- In single rack installations, the stabilizing feet are attached to the rack.
- In multiple rack installations, the racks are coupled.
- Only one rack component is extended at any time. A rack may become unstable if more than one rack component is extended for any reason.

Getting help

If you still have a question after reading this document, contact an HP authorized service provider or access our website: http://www.hp.com.

HP technical support

Telephone numbers for worldwide technical support are listed on the following HP website: http://www.hp.com/support/. From this website, select the country of origin.

Note: For continuous quality improvement, calls may be recorded or monitored.

Be sure to have the following information available before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

HP storage website

The HP website has the latest information on this product, as well as the latest drivers. Access storage at: http://www.hp.com/country/us/eng/prodserv/storage.html. From this website, select the appropriate product or solution.

HP authorized reseller

For the name of your nearest HP authorized reseller:

- In the United States, call 1-800-345-1518.
- Elsewhere, visit http://www.hp.com and click **Contact HP** to find locations and telephone numbers.

Troubleshooting Information

1

This chapter provides guidelines for troubleshooting the controller, cache module, and external cache battery (ECB). Topics include:

- Typical installation problem identification checklist and troubleshooting guidelines, page 20
- Significant event reporting, page 31
- Running the controller diagnostic test, page 41
- Caching techniques, page 44
- Device Discovery Error report, page 53
- SHOW ELEVATION report, page 56

Note: Refer to enclosure documentation for information on troubleshooting enclosure hardware, such as the power supplies, cooling fans, and environmental monitoring unit (EMU).

Typical installation problem identification checklist and troubleshooting guidelines

The following checklist identifies problems that occur in a typical installation. After identifying a problem, use Table 4 on page 22 to confirm the diagnosis and fix the problem.

If an initial diagnosis points to several possible causes, use the tools described in this chapter and then those in the “Utilities and Exercisers” chapter that starts on page 67 to further refine the diagnosis. If a problem cannot be diagnosed by using the checklist and tools, contact an HP authorized service provider for additional support.

To troubleshoot the controller and supporting modules, complete the following checklist:

Table 3: Installation Problem Identification Checklist

Item	Troubleshooting Task	Done (✓)
1.	At the first indication of a problem, and while you work through the CLI, enable your capture utility to begin capturing your actions and their results. This step saves time if you must escalate the problem later.	
2.	Check the power to the enclosure and enclosure components.	
	■ Are power cords connected properly?	
	■ Is power within specifications?	
3.	Check the component cables.	
	■ Are bus cables to the controllers connected properly?	
	■ For BA370 enclosures, are the ECB cables connected properly?	
4.	Check each program card to ensure that the card is fully seated.	
5.	Check the operator control panel (OCP) and devices for LED codes. See “Flashing OCP pattern display reporting” on page 32 and “Solid OCP pattern display reporting” on page 34 to interpret the LED codes.	
6.	Connect a local terminal to the controller and then check the controller with the following command: `SHOW ELEVATION`	

Table 3: Installation Problem Identification Checklist (Continued)

Item	Troubleshooting Task	Done (✓)
7.	Use the *Fault Management Utility* (*FMU*) for last failure or memory system failure entries. Show these codes and translate the Last Failure Codes they contain. For more information, see the "Utilities and Exercisers" chapter on page 67, "Displaying last failure entries" section that starts on page 68, and "Translating event codes" section that starts on page 70. If the controller failed so that it could not support a local terminal for *FMU*, check the host error log for the Instance or Last Failure Codes. To interpret the event codes, see the "Instance Codes" chapter that starts on page 177 and the "Last Failure Codes" chapter that starts on page 211.	
8.	If the controllers fail and restart repeatedly, issue the following *FMU* commands: ■ `SHOW LAST_ALL` *`FULL`* ■ `SHOW DEVICE_INFO` ■ `SHOW DEVICE_ERROR`	
9.	If the problem is recurring, synchronize the controller times and host times to help with further troubleshooting.	
10.	For recurring problems with hosts other than HP Tru64 UNIX and OpenVMS, log the console output in real time.	

After identifying a problem, use Table 4 to resolve the problem.

Table 4: Troubleshooting Guidelines (Sheet 1 of 9)

Symptom	Possible Cause	Investigation	Remedy
Reset button not lit.	No power to subsystem.	Check power to subsystem and power supplies on controller enclosure.	Replace cord or (BA370 enclosure only) AC input box.
		BA370 enclosure only: Ensure that all cooling fans are installed. If one or more fans are missing or all are inoperative for more than 8 minutes, the EMU shuts down the subsystem.	Turn off power switch on AC input box. Replace cooling fan. Restore power to subsystem.
		BA370 enclosure only: Determine if the standby power switch on the PVA was pressed for more than 5 seconds.	Press the alarm control switch on the EMU.
	Failed controller.	If the previous remedies fail to resolve the problem, check OCP LED codes.	Replace controller.
Reset button lit steadily; other LEDs also lit.	Various.	Note OCP LED Codes.	Follow repair action by using Table 5 on page 32.
Reset button flashing; other LEDs also lit.	Device in error or failedset on corresponding device port with other LEDs lit.	`SHOW` *`device FULL`*.	Follow repair action by using Table 6 on page 35.

Table 4: Troubleshooting Guidelines (Sheet 2 of 9)

Symptom	Possible Cause	Investigation	Remedy
Cannot set fail over to create dual-redundant configuration.	Incorrect command syntax.	See the controller CLI reference guide for the `SET FAILOVER` command.	Use the correct command syntax.
	Different software versions on controllers.	Check software versions on both controllers.	Update one or both controllers so that both use the same software version.
	Incompatible hardware.	Check hardware versions.	Upgrade controllers so that they use compatible hardware.
	Controller previously set for failover.	Ensure that neither controller is configured for failover.	Use the `SET NOFAILOVER` command on both controllers, then reset “this controller” for failover.
	Failed controller.	If the previous remedies fail to resolve the problem, check for OCP LED codes.	Follow repair action by using Table 5 on page 32 or Table 6 on page 35.

Table 4: Troubleshooting Guidelines (Sheet 3 of 9)

Symptom	Possible Cause	Investigation	Remedy
	Node ID is all zeros.	`SHOW_THIS` to see if node ID is all zeros.	Set node ID by using the node ID (bar code) that is located on the frame in which the controller sits. Refer to `SET THIS_CONTROLLER` *`NODE_ID`* in the controller CLI reference guide. Also, be sure to copy in the right direction. If cabled to the new controller, use `SET FAILOVER` *`COPY=OTHER_CONTROLLER`*. If cabled to the old controller, use `SET FAILOVER` *`COPY=THIS_CONTROLLER`*.
Nonmirrored cache: controller reports failed DIMM in Cache A or B.	Improperly installed DIMM.	Remove cache module and ensure that the DIMM is fully seated in the slot.	Reseat DIMM.
	Failed DIMM.	If the previous remedy fails to resolve the problem, check for OCP LED codes.	Replace DIMM.
Mirrored cache: "this controller" reports DIMM 1 or 2 failed in Cache A or B.	Improperly installed DIMM in "this controller" cache module.	Remove cache module and ensure that DIMMs are installed properly.	Reseat DIMM.
	Failed DIMM in "this controller" cache module.	If the previous remedy fails to resolve the problem, check for OCP LED codes.	Replace DIMM in "this controller" cache module.

Table 4: Troubleshooting Guidelines (Sheet 4 of 9)

Symptom	Possible Cause	Investigation	Remedy
Mirrored cache: "this controller" reports DIMM 3 or 4 failed in Cache A or B.	Improperly installed DIMM in "other controller" cache module.	Remove cache module and ensure that the DIMMs are installed properly.	Reseat DIMM.
	Failed DIMM in "other controller" cache module.	If the previous remedy fails to resolve the problem, check for OCP LED codes.	Replace DIMM in "other controller" cache module.
Mirrored cache: controller reports battery not present.	Memory module was installed before the cache module was connected to an ECB.	BA370 enclosure: ECB cable not connected to cache module. Model 2100 and 2200 enclosures: ECB not installed or seated properly in backplane.	BA370 enclosure: Connect ECB cable to cache module, and then restart both controllers by pushing their **Reset** buttons simultaneously. Model 2100 and 2200 enclosures: Install or reseat ECB.
Mirrored cache: controller reports cache or mirrored cache has failed.	Primary data and the mirrored copy data are not identical.	`SHOW THIS_CONTROLLER` indicates that the cache or mirrored cache has failed. Spontaneous *FMU* message displays: Primary cache declared failed—data inconsistent with mirror, or mirrored cache declared failed—data inconsistent with primary.	Enter the `SHUTDOWN` command on controllers that report the problem. (This command flushes the cache contents to synchronize the primary and mirrored data.) Restart the controllers that were shut down.

Table 4: Troubleshooting Guidelines (Sheet 5 of 9)

Symptom	Possible Cause	Investigation	Remedy
Invalid cache.	Mirrored-cache mode discrepancy. This discrepancy can occur after installing a new controller. The existing cache module is set for mirrored caching, but the new controller is set for unmirrored caching. This discrepancy can also occur if the new controller is set for mirrored caching, but the existing cache module is not.	`SHOW THIS_CONTROLLER` indicates invalid cache. Spontaneous *FMU* message displays: `Cache modules inconsistent with mirror mode.`	Connect a terminal to the maintenance port on the controller reporting the error and clear the error with the following command—all on one line: `CLEAR_ERRORS THIS_CONTROLLER INVALID_CACHE NODESTROY_ UNFLUSHED_DATA`. Refer to the controller CLI reference guide for more information.

Table 4: Troubleshooting Guidelines (Sheet 6 of 9)

Symptom	Possible Cause	Investigation	Remedy
	Cache module can erroneously contain unflushed writeback data. This can occur after installing a new controller. The existing cache module might indicate that the cache module contains unflushed writeback data, but the new controller expects to find no data in the existing cache module. This error can also occur if installing a new cache module for a controller that expects writeback data in the cache.	`SHOW THIS_CONTROLLER` indicates invalid cache. No spontaneous *FMU* message.	Connect a terminal to the maintenance port on the controller reporting the error, and clear the error with the following command—all on one line: `CLEAR_ERRORS THIS_CONTROLLER INVALID_CACHE DESTROY_UNFLUSHED_DATA`. Refer to the controller CLI reference guide for more information. Refer to the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Maintenance and Service Guide*.

Table 4: Troubleshooting Guidelines (Sheet 7 of 9)

Symptom	Possible Cause	Investigation	Remedy
Cannot add device.	Illegal device.	See product-specific release notes that accompanied the software release for the most recent list of supported devices.	Replace device.
	Device not properly installed in enclosure.	Ensure that the device is fully seated.	Firmly press the device into the bay.
	Failed device.	Check for presence of device LEDs.	Follow repair action in the documentation provided with the enclosure or device.
	Failed power supplies.	Check for presence of power supply LEDs.	Follow repair action in the documentation provided with the enclosure or power supply.
	Failed bus to device.	If the previous remedies fail to resolve the problem, check for OCP LED codes.	Replace enclosure.

Table 4: Troubleshooting Guidelines (Sheet 8 of 9)

Symptom	Possible Cause	Investigation	Remedy
Cannot configure storagesets.	Incorrect command syntax.	See the controller CLI reference guide for the appropriate ADD command.	Reconfigure storageset with correct command syntax.
	Exceeded maximum number of storagesets.	Use the SHOW STORAGESETS command to count the number of storagesets configured on the controller.	Delete unused storagesets.
	Failed battery on ECB. An ECB or uninterruptible power supply (UPS) is required for RAIDsets and mirrorsets.	Use the SHOW THIS command to check the ECB battery status.	Replace the ECB if required.
Cannot assign unit number to storageset.	Incorrect command syntax.	See the controller CLI reference guide for correct syntax.	Reassign the unit number with the correct syntax.
Unit is available but not online.	After created, the unit automaticaly comes online.	None.	None.
Host cannot see device.	Broken cables.	Check for broken cables.	Replace broken cables.

Table 4: Troubleshooting Guidelines (Sheet 9 of 9)

Symptom	Possible Cause	Investigation	Remedy
Host cannot access unit.	Host files or device drivers not properly installed or configured.	Check for the required device special files.	Configure device special files as described in the installation and configuration guide that accompanied the software release.
	Invalid Cache.	See the description for the invalid cache symptom on page 26.	See the description for the invalid cache symptom.
	Units have lost data.	Issue the `SHOW` *`unit-number`* *`FULL`* command.	Clear these units with: `CLEAR_ERRORS` *`unit-number`* `LOST_DATA`.
Host log file or maintenance terminal indicates that a forced error occurred while the controller was reconstructing a RAIDset or mirrorset.	Unrecoverable read errors might have occurred while the controller was reconstructing the storageset. A flawed data block was detected and reassigned to a good data block; however, the original data was unrecoverable. The reassigning of the data block has repaired the original problem, but the reassigned data block now contains invalid data. This is normal after a minor media flaw is detected.	Conduct a read scan of the storageset by using the appropriate utility from the host operating system, such as the *DD* utility for an HP Tru64 UNIX host.	Rebuild the storageset, and then restore storageset data from a backup source. While the controller is reconstructing the storageset, monitor the host error log activity or spontaneous event reports on the maintenance terminal for any unrecoverable errors. If unrecoverable errors persist, note the device on which they occurred, and replace the device before proceeding.

Significant event reporting

The controller fault management software reports information about significant events that occur. These events are reported by:

- Maintenance terminal displays.
- Host error logs.
- OCP LEDs.

Some events cause controller operation to halt; others allow the controller to remain operable. Both types of events are detailed in the following sections.

Reporting events that cause controller operation to halt

Events that cause the controller to halt operations are reported in three possible ways:

- A flashing OCP pattern display
- A solid OCP pattern display
- Last Failure reporting

Use Table 5 on page 32 to interpret flashing OCP patterns and Table 6 on page 35 to interpret solid (on) OCP patterns. In the Error column of the solid OCP patterns, there are two separate descriptions. The first denotes the actual error message that appears on the terminal, and the second provides a more detailed explanation of the designated error.

Use the following legend to interpret both tables as indicated:

- n = **Reset** button flashing (in Table 5) or on (in Table 6)
- o = **Reset** button off
- l = LED flashing (in Table 5) or on (in Table 6)
- m = LED off

Note: If the **Reset** button is flashing and an LED is on, either the devices on the bus that corresponds to the LED do not match the controller configuration, or an error occurred in one of the devices on that bus. Also, a single LED that is turned on indicates a failure of the drive on that bus.

Flashing OCP pattern display reporting

Certain events can cause a flashing display of the OCP LEDs. Each event and the resulting pattern are described in Table 5.

Note: Remember that a solid black pattern represents a flashing display. A white pattern indicates off. All LEDs flash at the same time and at the same rate.

Table 5: Flashing OCP Pattern Displays and Repair Actions

Pattern	OCP Code	Error	Repair Action
nmmmmml	1	`Program card EDC error.`	Replace program card.
nmmmlmm	4	`Timer zero on the processor is bad.`	Replace controller.
nmmmlml	5	`Timer one on the processor is bad.`	Replace controller.
nmmmllm	6	`Processor Guarded Memory Unit (GMU) is bad.`	Replace controller.
nmmlmll	B	`Nonvolatile Journal Memory (JSRAM) structure is bad because of a memory error or an incorrect upgrade procedure.`	Verify the correct upgrade (refer to the controller release notes and other related documentation, if available). If error continues, replace controller.
nmmllml	D	`One or more bits in the diagnostic registers did not match the expected reset value.`	Press the **Reset** button to restart the controller. If this does not correct the error, replace the controller.
nmmlllm	E	`Memory error in the JSRAM.`	Replace controller.
nmmllll	F	`Wrong image found on program card.`	Replace program card or replace controller if needed.
nmlmmmm	10	`Controller module memory is bad.`	Replace controller.

Table 5: Flashing OCP Pattern Displays and Repair Actions (Continued)

Pattern	OCP Code	Error	Repair Action
nmlmmlm	12	Controller module memory addressing is malfunctioning.	Replace controller.
nmlmmll	13	Controller module memory parity is not working.	Replace controller.
nmlmlmm	14	Controller module memory controller timer has failed.	Replace controller.
nmllmml	15	Controller module memory controller interrupt handler has failed.	Replace controller.
nmllllm	1E	During the diagnostic memory test, the controller module memory controller caused an unexpected Non-Maskable Interrupt (NMI).	Replace controller.
nlmmlmm	24	Card code image changed when the contents were copied to memory.	Replace controller.
nllmmmm	30	JSRAM battery is bad.	Replace controller.
nllmmlm	32	First-half diagnostics of the Time of Year Clock failed.	Replace controller.
nllmmll	33	Second-half diagnostics of the Time of Year Clock failed.	Replace controller.
nllmlml	35	Processor bus-to-device bus bridge chip is bad.	Replace controller.
nlllmll	3B	An unnecessary interrupt is pending.	Replace controller.

Table 5: Flashing OCP Pattern Displays and Repair Actions (Continued)

Pattern	OCP Code	Error	Repair Action
nllllmm	3C	`An unexpected fault occurred during initialization.`	Replace controller.
nllllml	3D	`An unexpected maskable interrupt occurred during initialization.`	Replace controller.
nlllllm	3E	`An unexpected NMI occurred during initialization.`	Replace controller.
nllllll	3F	`An invalid process ran during initialization.`	Replace controller.

Solid OCP pattern display reporting

Certain events cause the OCP LEDs to display on or solid. Each event and the resulting pattern are described in Table 6 on page 35.

Information related to the solid OCP patterns is automatically displayed on the maintenance terminal (unless disabled with the *FMU*) and use %FLL formatting (see Figure 1).

```
%FLL--HSG> --13-MAY-2004 04:39:45 (time not set)-- OCP Code: 38
Controller operation terminated.

%FLL--HSG> --13-MAY-2004 04:32:26 (time not set)-- OCP Code: 26
Memory module is missing.
```

Figure 1: OCP pattern display showing %FLL formatting

Table 6: Solid OCP Pattern Displays and Repair Actions (Sheet 1 of 5)

Pattern	OCP Code	Error	Repair Action
ommmmmm	0	`Catastrophic controller or power failure occurred.`	Check power. If good, reset controller. If problem persists, reseat controller module and reset controller. If problem is still evident, replace controller module.
nmmmmmm	0	`No program card detected or kill asserted by` *`OTHER CONTROLLER`*`.` Controller unable to read program card.	Ensure that the program card is properly seated while resetting the controller. If the error persists, try the card with another controller; or replace the card. Otherwise, replace the controller that reported the error.
nlmmlml	25	`Recursive bugcheck detected.` The same bugcheck has occurred three times within 10 minutes, and controller operation has halted.	**Reset** the controller. If this fault pattern is displayed repeatedly, follow the repair actions associated with the Last Failure Code that is repeatedly terminating controller execution.
nlmmllm	26	`Indicated memory module is missing.` Controller is unable to detect a particular memory module.	Insert memory module (cache board).
nlmmlll	27	`Memory module has insufficient usable memory.`	Replace indicated DIMMs. This indication is only provided after Fault LED logging is enabled.
nlmlmmm	28	`An unexpected Machine Fault NMI occurred during Last Failure processing.` A machine fault was detected while a NMI was processing.	**Reset** the controller.

Table 6: Solid OCP Pattern Displays and Repair Actions (Sheet 2 of 5)

Pattern	OCP Code	Error	Repair Action
nlmlmml	29	`EMU protocol version incompatible.` The microcode in the EMU and the software in the controller are not compatible.	Upgrade either the EMU microcode or the software (refer to the release notes that accompanied the controller software).
nlmlmlm	2A	`All enclosure I/O modules are not of the same type.` Enclosure I/O modules are a combination of single-ended and differential.	Ensure that the I/O modules in an extended subsystem are either all single-ended or all differential, but not both.
nlmlmll	2B	`Jumpers, not terminators, found on backplane.` One or more SCSI bus terminators are either missing from the backplane or broken.	Ensure that enclosure SCSI bus terminators are installed and that no jumpers are installed. Replace the failed terminator if the problem continues.
nlmllmm	2C	`Enclosure I/O termination power out of range.` Faulty or missing I/O module causes enclosure I/O termination power to be out of range.	Ensure that all of the enclosure device SCSI buses have an I/O module. If problem persists, replace the failed I/O module.
nlmllml	2D	`Master enclosure SCSI buses are not all set to ID 0.`	Set the PVA ID to 0 for the enclosure with the controllers. If the problem persists, try the following repair actions: 1. Replace the PVA module. 2. Replace the EMU. 3. Remove all devices. 4. Replace the enclosure.

Table 6: Solid OCP Pattern Displays and Repair Actions (Sheet 3 of 5)

Pattern	OCP Code	Error	Repair Action
nlmlllm	2E	`Multiple enclosures have the same SCSI ID.` `More than one enclosure has the same SCSI ID.`	Reconfigure the PVA ID to uniquely identify each enclosure in the subsystem. The enclosure with the controllers must be set to PVA ID 0; additional enclosures must use PVA IDs 2 and 3. If the error continues after PVA settings are unique, replace each PVA module one at a time. Check the enclosure if the problem remains.
nlmllll	2F	`Memory module has illegal DIMM configuration.`	Verify that DIMMs are installed correctly.
nllmmmm	30	`An unexpected bugcheck occurred before subsystem initialization completed.` An unexpected Last Failure occurred during initialization.	Reinsert controller. If the problem persists, reset the controller. If the error persists, try resetting the controller again, and replace the controller if no change occurs.
nllmmml	31	`ILF$INIT unable to allocate memory.` Attempt to allocate memory by `ILF$INIT` failed.	Replace controller.
nllmmlm	32	`Code load program card write failure.` Attempt to update program card failed.	Replace program card.
nllmmll	33	`Nonvolatile program memory (NVPM) structure revision too low.` NVPM structure revision number is lower than can be handled by the software version attempting to be executed.	Verify that the program card contains the latest software version. If the error persists, replace controller.

Table 6: Solid OCP Pattern Displays and Repair Actions (Sheet 4 of 5)

Pattern	OCP Code	Error	Repair Action
nllmlml	35	`An unexpected bugcheck occurred during Last Failure processing.` Last failure processing interrupted by another last failure event.	**Reset** controller.
nllmllm	36	`Hardware-induced controller reset expected and failed.`	Replace controller.
nllmlll	37	`Software-induced controller reset expected and failed.`	Replace controller.
nlllmmm	38	`Controller operation halted.` Last Failure event required termination of controller operation, for example: `SHUTDOWN` through the CLI.	**Reset** controller.
nlllmml	39	`NVPM configuration inconsistent.` Device configuration within the NVPM is inconsistent.	Replace controller.
nlllmlm	3A	`An unexpected NMI occurred during Last Failure processing.` Last Failure processing interrupted by an NMI.	Replace controller.
nlllmll	3B	`NVPM read loop hang occurred.` Attempt to read data from NVPM failed.	Replace controller.

Table 6: Solid OCP Pattern Displays and Repair Actions (Sheet 5 of 5)

Pattern	OCP Code	Error	Repair Action
nllllmm	3C	`NVPM write loop hang occurred.` Attempt to write data to NVPM failed.	Replace controller.
nllllml	3D	`NVPM structure revision is higher than image.` NVPM structure revision number is higher than the one that can be handled by the software version attempting to execute.	Replace program card with one that contains the latest software version.
nllllll	3F	`DAEMON diagnostic failed hard in non-fault tolerant mode.` DAEMON diagnostic detected critical hardware component failure; controller can no longer operate.	Verify that cache module is present. If the error persists, replace controller.

Last failure reporting

Last Failures are automatically displayed on the maintenance terminal (unless disabled through the *FMU*) and use %LFL formatting (see Figure 2).

```
%LFL--HSG> --13-MAY-2004 04:39:45 (time not set)-- Last Failure
Code: 20090010
 Power On Time: 0. Years, 14. Days, 19. Hours, 58. Minutes, 42.
Seconds
 Controller Model: HSG80
 Serial Number: AA12345678 Hardware Version: 0000(00)
 Software Version: V088P(FF)
 Informational Report
 Instance Code: 0102030A
 Last Failure Code: 20090010 (No Last Failure Parameters)

 Additional information is available in Last Failure Entry: 1.
```

Figure 2: Sample Last Failure report

Last Failures are also reported to the host error log on Template 01, following a restart of the controller. For a detailed explanation of this template, see the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161.

Reporting events that allow controller operation to continue

Events that do not cause controller operation to halt are displayed in one of two ways:

- Spontaneous Event log
- CLI Event reporting

Spontaneous Event log

Spontaneous Event logs are automatically displayed on the maintenance terminal (unless disabled with the *FMU*) and use `%EVL` formatting, as illustrated in Figure 3.

```
%EVL--HSG> --13-OCT-2004 04:32:47 (time not set)-- Instance Code: 0102030A (not yet
reported to host)
Template: 1.(01)
Power On Time: 0. Years, 14. Days, 19. Hours, 58. Minutes, 43. Seconds
Controller Model: HSG80
Serial Number: AA12345678 Hardware Version: 0000(00)
Software Version: V088P(FF)
Informational Report
Instance Code: 0102030A
Last Failure Code: 011C0011
Last failure parameter[0.] 0000003F

%EVL--HSG> --13-OCT-2004 04:32:47 (time not set)-- Instance Code: 82042002 (not yet
reported to host)
Template: 13.(13)
Power On Time: 0. Years, 14. Days, 19. Hours, 58. Minutes, 43. Seconds
Controller Model: HSG80
Serial Number: AA12345678 Hardware Version: 0000(00)
Software Version: V088P(FF)
Header type: 00 Header flags: 00
Test entity number: 0F Test number Demand/Failure: F8 Command: 01
Error Code: 0008 Return Code: 0005 Address of Error: A0000000
Expected Error Data: 44FCFCFC Actual Error Data: FFFF01BB
Extra Status(1): 00000000 Extra Status(2): 00000000 Extra Status(3): 00000000
Instance Code: 82042002
HSG>
```

Figure 3: Sample Spontaneous Event logs showing %EVL formatting

Spontaneous Event logs are reported to the Host Error log on SCSI Sense Data Templates 01, 04, 05, 11, 12, 13, 14, 41, 51, and 90. See the “Event Reporting Templates” chapter on page 135 for a detailed explanation of templates.

CLI Event reporting

CLI Event reports are automatically displayed on the maintenance terminal (unless disabled with the *FMU*) and use `%CER` formatting, as shown in the following example:

```
%CER--HSG> --13-OCT-2004 04:32:20 (time not set)-- Previous controller-
operation stopped with display of solid fault code, OCP Code: 3F
HSG>
```

Figure 4: Sample CLI Event report showing %CER formatting

Running the controller diagnostic test

During startup, the controller automatically tests the device ports, host ports, cache module, and value-added functions. If intermittent problems occur with one of these components, run the controller diagnostic test in a continuous loop rather than restarting the controller repeatedly.

Use the following steps to run the controller diagnostic test:

1. Connect a terminal to the controller maintenance port.
2. Start the self-test with one of the following commands:

   `SELFTEST THIS_CONTROLLER`

   `SELFTEST OTHER_CONTROLLER`

Note: The self-test runs until it detects an error or until you press the **Reset** button.

If the self-test detects an error, the self-test saves information about the error and produces an OCP LED code for a `daemon hard error`. Restart the controller to write the error information to the host error log, then check the host error log for a `built-in self-test failure` event report. This report contains an Instance Code, located at offset 32 through 35, that can be used to determine the cause of the error. See the “Translating event codes” section that starts on page 70 for help translating Instance Codes.

ECB charging diagnostics

After restarting the controller, the diagnostic routines automatically check the charge of each ECB battery. If the battery is fully charged, the controller reports the battery as good and rechecks the battery every 24 hours. If the battery is charging, the controller rechecks the battery every 4 minutes. A battery is reported as being either above or below 50 percent capacity. A battery below 50 percent capacity is referred to as low.

The 4-minute polling continues for the maximum allowable time to recharge the battery—up to 10 hours for a BA370 enclosure, or 3 1/2 hours for a Model 2100 or 2200 enclosure. If the battery does not charge sufficiently after the allotted time, the controller declares the battery as failed.

Battery hysteresis

If you are charging an ECB battery, writeback caching is allowed as long as a previous downtime did not drain more than 50 percent battery capacity. If an ECB battery is operating below 50 percent capacity, the battery is considered to be low and writeback caching is disabled.

ECB battery capacity depends on the size of the cache module memory configuration as shown in Table 7. For example, after the batteries are fully charged, an ECB can preserve 512 MB of cache memory for 24 hours.

Table 7: ECB Capacity Based on Memory Size

Size	DIMM Combinations	Capacity in Hours (Days)
128 MB	Four, 32 MB each	96 (4)
128 MB	One, 128 MB each	96 (4)
256 MB	Two, 128 MB each	48 (2)
512 MB	Four, 128 MB each	24 (1)

Caution: HP recommends replacing the ECB every 3 1/2 years to prevent battery failure. If you are shutting down your controller for longer than one day, complete the additional steps in "Shutting Down the Subsystem" in the *HP StorageWorks HSG60 and HSG80 Array Controller and Array Controller Software Maintenance and Service Guide*. This prevents the ECB from discharging during planned power outages.

UPS used for backup power

If a UPS is used for backup power and the controllers are set to DATACENTER_WIDE, the controllers check the battery and indicate if a battery failure exists, but they do not take any action (see Figure 5 for an example of the screen display after issuing the SHOW THIS CLI command):

```
HSG> SHOW THIS
Controller:
        HSG80 ZG93413884 Software V88.x-0, Hardware  E06
        NODE_ID          = 5000-1FE1-0002-A270
        ALLOCATION_CLASS = 0
        SCSI_VERSION     = SCSI-2
        Configured for MULTIBUS_FAILOVER with ZG93513566
            In dual-redundant configuration
        Device Port SCSI address 6
        Time: 29-JUN-2004 13:45:57
        Command Console LUN is lun 0 (IDENTIFIER = 300)
        Host Connection Table is LOCKED
        Smart Error Eject Disabled
    .
    .
    .
Battery:
        UPS = DATACENTER_WIDE
        FULLY CHARGED
        Expires:             18-JUN-2007
Previous controller operation terminated by power failure.
```

Figure 5: SHOW THIS CLI sample screen display

Refer to the appropriate installation and configuration guide and controller CLI reference guide for information about the UPS switches.

Caching techniques

The cache module supports the following caching techniques to increase subsystem read and write performance:

- Read caching
- Read-ahead caching
- Write-through caching
- Writeback caching

Read caching

If the controller receives a read request from the host, the controller reads the data from the disk drives, delivers the data to the host, and stores the data in the supporting cache module. Subsequent reads for the same data take this data from the supporting cache module rather than access the data from the disk drives. This process is called read caching.

Read caching can decrease the subsystem response time to many host read requests. If the host requests some or all of the cached data, the controller satisfies the request from the supporting cache module rather than from the disk drives. Read caching is enabled by default for all storage units.

For more details, refer to the following CLI commands in the controller CLI reference guide:

- `SET` *`unit-number MAXIMUM_CACHED_TRANSFER=nn`*
- `SET` *`unit-number MAX_READ_CACHED_TRANSFER_SIZE=nn`*
- `SET` *`unit-number READ_CACHE`*

Read-ahead caching

Read-ahead caching begins after the controller has already processed a read request and the controller receives a subsequent read request from the host. If the controller does not find the data in the cache memory, the controller reads the data from the disk drives and sends this data to the cache memory.

During read-ahead caching, the controller anticipates subsequent read requests and begins to prefetch the next blocks of data from the disk drives as the controller sends the requested read data to the host. These are parallel actions. The controller notifies the host of the read completion, and subsequent sequential read requests are satisfied from the cache memory. Read-ahead caching is enabled by default for all disk units.

Write-through caching

After the controller receives a write request from the host, the controller places the data in the supporting cache module, writes the data to the disk drives, and then notifies the host that the write operation is complete. This process is called write-through caching because the data actually passes through—and is stored in—the cache memory along the way to the disk drives.

If read caching is enabled for a storage unit, write-through caching is automatically enabled.

Writeback caching

Writeback caching improves the subsystem response time to write requests by allowing the controller to declare the write operation *complete* as soon as the data reaches the supporting cache memory. The controller performs the slower operation of writing the data to the disk drives at a later time. For more details, refer to the following CLI commands in the controller CLI reference guide:

- `SET` *`unit-number MAXIMUM_CACHED_TRANSFER=nn`*
- `SET` *`unit-number MAX_WRITE_CACHED_TRANSFER_SIZE=nn`*
- `SET` *`unit-number WRITEBACK_CACHE`*

Writeback caching is enabled by default for all units. The controller only provides writeback caching to a unit if the cache memory is nonvolatile, as described in the next section.

By default, the controller expects to use an ECB as the backup power source for the cache module. However, if the subsystem is protected by a UPS, use one of the following CLI commands to instruct the controller to use the UPS:

`SET` *`controller UPS=NODE_ONLY`*
or
`SET` *`controller UPS=DATACENTER_WIDE`*

Fault-tolerance for writeback caching

The cache module supports nonvolatile memory and dynamic cache policies to protect the availability of cache module unwritten (writeback) data.

Nonvolatile memory

The controller provides writeback caching for storage units as long as the controller cache memory is connected to a nonvolatile backup power source, such as an ECB. The cache module must be nonvolatile to preserve unwritten cache data during a power failure. If the cache memory is not connected to a backup power supply, this unwritten data is lost during a power failure.

Note: Disaster-tolerant mirrorsets are not subject to this requirement.

By default, the controller expects to use an ECB as the backup power source for the supporting cache module. However, if the subsystem is backed up by using a UPS, two options are available that tell the controller to use the UPS:

- For BA370 enclosures only, use the ECB and the UPS together with the following CLI command:

  SET *controller UPS=NODE_ONLY*

- Use only the UPS as the backup power source with the following CLI command:

  SET *controller UPS=DATACENTER_WIDE*

See the controller CLI reference guide for detailed descriptions of these commands.

Cache policies resulting from cache module failures

If the controller detects a full or partial failure of the supporting cache module or ECB, the controller automatically reacts to preserve the unwritten data in the supporting cache module. Depending upon the severity of the failure, the controller chooses an interim caching technique—also called the cache policy—until the cache module or ECB is repaired or replaced.

Table 8 shows the cache policies resulting from a full or partial failure of cache module A (Cache A) in a dual-redundant controller configuration. The consequences shown in Table 8 are the same for Cache B failures.

Table 9 on page 50 shows the cache policies resulting from a full or partial failure of the ECB connected to Cache A in a dual-redundant controller configuration. The consequences shown in Table 9 are the opposite for an ECB failure connected to Cache B.

- If the ECB is at least 50% charged, the ECB is still good and is charging.
- If the ECB is less than 50% charged, the ECB is low but still charging.

Table 8: Cache Policies—Cache Module Status

Cache Module Status		Cache Policy	
Cache A	Cache B	Unmirrored Cache	Mirrored Cache
Good.	Good.	Data loss: None. Cache policy: Both controllers support writeback caching. Failover: None.	Data loss: None. Cache policy: Both controllers support writeback caching. Failover: None.

Table 8: Cache Policies—Cache Module Status (Continued)

Cache Module Status		Cache Policy	
Cache A	**Cache B**	**Unmirrored Cache**	**Mirrored Cache**
Multibit cache memory failure.	Good.	Data loss: Forced error and loss of writeback data for which the multibit error occurred. Controller A detects and reports the lost blocks. Cache policy: Both controllers support writeback caching. Failover: None.	Data loss: None. Controller A recovers lost writeback data from the mirrored copy on Cache B. Cache policy: Both controllers support writeback caching. Failover: None.

Table 8: Cache Policies—Cache Module Status (Continued)

Cache Module Status		Cache Policy	
Cache A	**Cache B**	**Unmirrored Cache**	**Mirrored Cache**
DIMM or cache memory controller chip failure.	Good.	Data loss: Writeback data that was not written to media when failure occurred was not recovered. Cache policy: Controller A supports write-through caching only; Controller B supports writeback caching. ■ Failover: In Transparent Failover, all units fail over to Controller B. In Multiple-bus Failover with host-assist, only those units that use writeback caching, such as RAIDsets and mirrorsets, fail over to Controller B. All units with lost data become inoperative until they are cleared by using the `CLEAR_ERRORS` *`unit-number`* *`LOST_DATA`* command. Units that did not lose data operate normally on Controller B. In single-controller configurations, RAIDsets, mirrorsets, and all units with lost data become inoperative. Although lost data errors can be cleared on some units, RAIDsets and mirrorsets remain inoperative until the memory on Cache A is repaired or replaced.	Data loss: Controller A recovers all of writeback data from the mirrored copy on Cache B. Cache policy: Controller A supports write-through caching only; Controller B supports writeback caching. Failover: In Transparent Failover, all units fail over to Controller B and operate normally. In Multiple-bus Failover with host-assist, only those units that use writeback caching, such as RAIDsets and mirrorsets, fail over to Controller B.

Table 8: Cache Policies—Cache Module Status (Continued)

Cache Module Status		Cache Policy	
Cache A	**Cache B**	**Unmirrored Cache**	**Mirrored Cache**
Cache board failure.	Good.	Same as for DIMM failure (see page 49).	Data loss: Controller A recovers all of writeback data from the mirrored copy on Cache B. Cache policy: Both controllers support write-through caching only. Controller B cannot execute mirrored writes because Cache A cannot mirror Controller B unwritten data. Failover: None

Table 9: Resulting Cache Policies—ECB Status

ECB Status		Cache Policy	
Cache A	**Cache B**	**Unmirrored Cache**	**Mirrored Cache**
At least 50% charged.	At least 50% charged.	Data loss: None. Cache policy: Both controllers continue to support writeback caching. Failover: None.	Data loss: None. Cache policy: Both controllers continue to support writeback caching. Failover: None.

Table 9: Resulting Cache Policies—ECB Status (Continued)

ECB Status		Cache Policy	
Cache A	**Cache B**	**Unmirrored Cache**	**Mirrored Cache**
Less than 50% charged.	At least 50% charged.	Data loss: None. Cache policy: Controller A supports write-through caching only; Controller B supports writeback caching. Failover: In Transparent Failover, all units fail over to Controller B. In Multiple-bus Failover with host-assist, only those units that use writeback caching, such as RAIDsets and mirrorsets, fail over to Controller B. In single-controller configurations, the controller only provides write-through caching to the units.	Data loss: None. Cache policy: Both controllers continue to support writeback caching. Failover: None.
Failed.	At least 50% charged.	Data loss: None. Cache policy: Controller A supports write-through caching only; Controller B supports writeback caching. Failover: In Transparent Failover, all units fail over to Controller B and operate normally. In Multiple-bus Failover with host-assist, only those units that use writeback caching, such as RAIDsets and mirrorsets, fail over to Controller B. In single-controller configurations, the controller only provides write-through caching to the units.	Data loss: None. Cache policy: Both controllers continue to support writeback caching. Failover: None.

Table 9: Resulting Cache Policies—ECB Status (Continued)

ECB Status		Cache Policy	
Cache A	**Cache B**	**Unmirrored Cache**	**Mirrored Cache**
Less than 50% charged.	Less than 50% charged.	Data loss: None. Cache policy: Both controllers support write-through caching only. Failover: None.	Data loss: None. Cache policy: Both controllers support write-through caching only. Failover: None.
Failed.	Less than 50% charged.	Data loss: None. Cache policy: Both controllers support write-through caching only. Failover: In Transparent Failover, all units fail over to Controller B and operate normally. In Multiple-bus Failover with host-assist, only those units that use writeback caching, such as RAIDsets and mirrorsets, fail over to Controller B. In single-controller configurations, the controller only provides write-through caching to the units.	Data loss: None. Cache policy: Both controllers support write-through caching only. Failover: None.
Failed.	Failed.	Data loss: None. Cache policy: Both controllers support write-through caching only. Failover: None. RAIDsets and mirrorsets become inoperative. Other units that use writeback caching operate with write-through caching only. No restart occurs.	Data loss: None. Cache policy: Both controllers support write-through caching only. Failover: None. RAIDsets and mirrorsets become inoperative. Other units that use writeback caching operate with write-through caching only. A restart occurs.

Dual external cache battery failures

The array controller cache policy provides for proper handling of a single ECB failure as described in this guide. For dual ECB failures, it states that no failover occurs. If a dual ECB failure is detected, both controllers are restarted.

Enabling mirrored writeback cache

Before configuring dual-redundant controllers and enabling mirroring, ensure that the following conditions are met:

- Each cache module is configured with the same size cache, 128 MB, 256 MB, or 512 MB.
- Diagnostics indicate that cache is good on both cache modules.
- Both cache modules either:
  - Have an ECB connected, and the UPS switch is set by one of the following CLI commands:

    `SET` *`controller NOUPS`* (no UPS is connected)

    BA370 enclosure only: `SET` *`controller UPS=NODE_ONLY`* (a UPS is connected)
  - Do not have an ECB connected, and the UPS switch is set by the following CLI command:

    `SET` *`controller UPS=DATACENTER_WIDE`*
- No unit errors are outstanding (for example, lost data or data that cannot be written to devices).
- Both controllers are started and configured in Failover mode.

For important considerations while configuring a subsystem for mirrored caching, refer to the appropriate installation and configuration guide. To add or replace DIMMs in a mirrored cache configuration, refer to the controller maintenance and service guide.

Device Discovery Error report

The Device Discovery Error report contains information that the controller reports to the maintenance console if it encounters errors in the Device Discovery Code (see Figure 6 on page 54).

```
%EVL--hsg80_bot> --08-JUN-2004 11:37:26-- Instance Code: 03D04002
Template: 65.(41)
Occurred on 08-JUN-2004 at 11:37:11
Power On Time: 2. Years, 79. Days, 13. Hours, 34. Minutes, 26. Seconds
Controller Model: HSG80
Serial Number: ZG95114377 Hardware Version:  E11(29)
Software Version: V88F-0(FF)
Port: 1. Target: 3.
ASC: (3F) ASCQ: (85)
OP|KEY: x0004     ST: x17     EC: 9.
```

❶ ❷ ❸ ❹ ❺

❶ Test unit ready or read capacity command failed (refer to Table 48 on page 162).

❷ SCSI OpCode, where *00* represents the OpCode.

❸ Sense key, where *04* represents the sense key.

❹ Device work descriptor (DWD) status (see Table 10 on page 54).

❺ DWD Error Codes (see Table 11 on page 56).

Figure 6: Sample Device Discovery Error Report

Table 10 explains the DWD Status Codes.

Table 10: DWD Status Codes

Code	Description
0x00	Worked.
0x01	Compare operation failed.
0x02	VA must re-do entire XOR.
0x03	VA must re-do XOR for transfer for one or more buffers.
0x04	Drive is not responding properly.
0x05	DWD was aborted.
0x06	Tape has a serious exception.
0x07	Tape position was lost.
0x08	Cache data lost.

Table 10: DWD Status Codes (Continued)

Code	Description
0x09	Short record.
0x0a	Long record.
0x0b	Tape flow interlocked condition.
0x0c	Some of the data is missing.
0x0d	Data is good, command retried.
0x0e	Data is good, device retried.
0x0f	Device reported media error.
0x10	From device sense data.
0x11	Device reported media error.
0x12	Device reported write protect.
0x13	Disk reported ILI, FM or EOM.
0x14	Device reported.
0x15	See sense data for error.
0x16	LUN responded that it was not ready.
0x17	No response from targets.
0x18	Retry requested by ER thread.
0x19	Init only—DWD which initiated reset.
0x20	Deferred error for tape DWD.
0x21	Data is good, recommend revector.
0x22	Data is good, recommend re-write.
0x23	Request sense failed for command.
0x24	Request sense failed for command.
0x25	Media may have changed.
0x26	A drive reported forced error.
The following codes are disk-specific and are never seen by VA.	
0x27	An unexpected SCSI status byte was returned in response to a CDI SCSI command.
0x28	A `CDI MSJ OUT` byte was unexpectedly rejected by the device.
0x29	A severe error occurred for a CDI SCSI command.

Table 11 explains the Error Codes (EC).

Table 11: EC Codes

Code	Description
0	Spin failed on drive.
1	Pub device type does not match NVMEM.
2	Unknown device type.
3	Block size not 512 bytes.
4	Exhausted all command retries.
5	Unsupported capacity (too large). [1]
6	Blank check from drive.
7	Illegal operation code or field in operation code.
8	Vendor unique problem.
9	Drive is not responding to us.
10	Error with the media.
11	Drive is not functioning.
13	Drive tells us it is not ready.
14	Drive failed self diagnotic tests.
15	Error comes from drive hardware.
29	Failure code not yet documented, add new one or see JY.

1. Drive capacities greater than 146 GB are not supported by HSG60 and HSG80 array controllers.

SHOW ELEVATION report

The `SHOW ELEVATION` command retrieves most of the data about a controller by using one command. The following pages show a sample of the output generated after a `SHOW ELEVATION` command is issued.

```
hsg80_bot> show elevation

        Nindy is currently OFF

        Time: 05-JUN-2004 12:00:21
       Power On Time: 0. Years, 0. Days, 0

*****************************************
        This controller information in fu
*****************************************

Controller:
        HSG80 ZG95114377 Software V88S-1,
        NODE_ID          = 5000-1FE1-0001
        ALLOCATION_CLASS = 0
        SCSI_VERSION     = SCSI-3
        Configured for MULTIBUS_FAILOVER
            In dual-redundant configurati
        Device Port SCSI address 6
        Time: 05-JUN-2004 12:00:22
        Command Console LUN is lun 0 (NOI
        Host Connection Table is NOT lock
        Smart Error Eject Disabled
Host PORT_1:
        Reported PORT_ID = 5000-1FE1-0001
        PORT_1_TOPOLOGY  = FABRIC (fabric
        Address          = 151100
Host PORT_2:
        Reported PORT_ID = 5000-1FE1-0001
        PORT_2_TOPOLOGY  = FABRIC (fabric
        Address          = 151300
        NOREMOTE_COPY
Cache:
        256 megabyte write cache, version
        Cache is GOOD
        No unflushed data in cache
        CACHE_FLUSH_TIMER = DEFAULT (10 s
Mirrored Cache:
        256 megabyte write cache, version
        Cache is GOOD
        No unflushed data in cache
Battery:
        NOUPS
        FULLY CHARGED
        Expires:            16-MAY-2007
Extended information:
        Terminal speed 9600 baud, eight b
        Operation control: 00000000  Secu
        Configuration backup disabled
        Unit Default access enabled
        SCSI Fairness Disabled
        Vendor ID: DEC
```

```
**************************************************************
        Other controller information in full (SHOW OTHER FULL).
**************************************************************

Controller:
        HSG80 ZG12345678 Software V8.8S-1, Hardware 0000
        NODE_ID          = 5000-1FE1-0001-E200
        ALLOCATION_CLASS = 0
        SCSI_VERSION     = SCSI-3
        Configured for MULTIBUS_FAILOVER with ZG95114377
            In dual-redundant configuration
        Device Port SCSI address 7
        Time: 05-JUN-2004 12:00:26
        Command Console LUN is lun 0 (NOIDENTIFIER)
        Host Connection Table is NOT locked
        Smart Error Eject Disabled
Host PORT_1:
        Reported PORT_ID = 5000-1FE1-0001-E203
        PORT_1_TOPOLOGY  = FABRIC (fabric up)
        Address          = 151000
Host PORT_2:
        Reported PORT_ID = 5000-1FE1-0001-E204
        PORT_2_TOPOLOGY  = FABRIC (fabric up)
        Address          = 151200
        NOREMOTE_COPY
Cache:
        256 megabyte write cache, version 0022
        Cache is GOOD
        No unflushed data in cache
        CACHE_FLUSH_TIMER = DEFAULT (10 seconds)
Mirrored Cache:
        256 megabyte write cache, version 0022
        Cache is GOOD
        No unflushed data in cache
Battery:
        NOUPS
        FULLY CHARGED
        Expires:            16-MAY-2007
Extended information:
        Terminal speed 9600 baud, eight bit, no parity, 1 stop bit
        Operation control: 00000000  Security state code: 6894
        Configuration backup disabled
        Unit Default access enabled
        SCSI Fairness Disabled
        Vendor ID: DEC

**************************************************************
        Information of all remote copy sets in full (SHOW REMOTE FULL).
**************************************************************
No REMOTE_COPY_SETS

**************************************************************
        Information of all association sets in full (SHOW ASSOCIATION
FULL).
**************************************************************
No ASSOCIATIONS
```

```
***************************************************************
        Information of all connections in full (SHOW CONNECTION FULL).
***************************************************************

Connection
   Name      Operating system    Controll
Offset

!NEWCON29        VMS            THIS
      HOST_ID=2000-0000-C927-6191     AD

!NEWCON30        VMS            THIS
      HOST_ID=2000-0000-C927-6191     AD

!NEWCON31        VMS            THIS
      HOST_ID=2000-0000-C923-01EA     AD

!NEWCON32        VMS            THIS
      HOST_ID=2000-0000-C923-01EA     AD

!NEWCON33        VMS            OTHER
      HOST_ID=2000-0000-C927-6191     AD

!NEWCON34        VMS            OTHER
      HOST_ID=2000-0000-C927-6191     AD

!NEWCON35        VMS            OTHER
      HOST_ID=2000-0000-C923-01EA     AD

!NEWCON36        VMS            OTHER
      HOST_ID=2000-0000-C923-01EA     AD

No rejected Hosts

Connection Summary:
------------------
Maximum Allowed Connections = 96
Used Connections = 8
Free Connections = 88
Rejected Connections = 0
```

```
***************************************************************
        Management information (SHOW MANAGER).
***************************************************************

Connection              <<<All Connections Enabled>>>
   Name      Operating System    Controller  Port    Address    Status

!NEWCON29        VMS            THIS         1    151F00    OL this   0
      HOST_ID=2000-0000-C927-6191     ADAPTER_ID=1000-0000-C927-6191

!NEWCON30        VMS            THIS         2    151F00    OL this   100
      HOST_ID=2000-0000-C927-6191     ADAPTER_ID=1000-0000-C927-6191

!NEWCON31        VMS            THIS         1    151E00    OL this   0
      HOST_ID=2000-0000-C923-01EA     ADAPTER_ID=1000-0000-C923-01EA

!NEWCON32        VMS            THIS         2    151E00    OL this   100
      HOST_ID=2000-0000-C923-01EA     ADAPTER_ID=1000-0000-C923-01EA

!NEWCON33        VMS            OTHER        1    151F00    OL other  0
      HOST_ID=2000-0000-C927-6191     ADAPTER_ID=1000-0000-C927-6191

!NEWCON34        VMS            OTHER        2    151F00    OL other  100
      HOST_ID=2000-0000-C927-6191     ADAPTER_ID=1000-0000-C927-6191

!NEWCON35        VMS            OTHER        1    151E00    OL other   0
      HOST_ID=2000-0000-C923-01EA     ADAPTER_ID=1000-0000-C923-01EA

!NEWCON36        VMS            OTHER        2    151E00    OL other  100
      HOST_ID=2000-0000-C923-01EA     ADAPTER_ID=1000-0000-C923-01EA

                        <<<All Connections Enabled>>>

***************************************************************
        VSI tree information in full (DEBUG VA SHOW_CONFIG_ALL).
***************************************************************
     Nv  St  Up   Us   Dn   Ds
-------------------------------
#### 0021 4 fffe 0020 000e fffe Un D5 USB c0de8070 0 Part 0363a000 00000000
#### 0020 4 fffe 001f 000e fffe Un D4    USB c0de8b90  1 Part 028ab800 00000000
#### 001f 4 fffe 0010 000e fffe Un D3    USB c0de96b0  2 Part 01b1d000 00000000
#### 0010 4 fffe 000f 000e fffe Un D2    USB c0dea1d0  3 Part 00d8e800 00000000
#### 000f 4 fffe fffe 000e fffe Un D1    USB c0deacf0  4 Part 00000000 00000000
 ### 000e 4 0021 fffe 000b fffe St      RSDB 80fa8fec mem  4
   # 000b 4 000e fffe fffe 0029 Dv 1:1:0 PUB c0488054 Type 00  Pub st    6 ri  2
 BLOX: vaso 17769177, vabbro 17769177, vafediro 17769179, vafeo 17769181
vaconfo 17773521, vaid1 17773522, vsilbnsiz 17769177, vsicontsiz 0  mdatav 11,
nodest 0, prev_online 0, size_val 1, id0_gd 0, id1_gd 0, save_c 0, parted 1,
sc-dis 0 fe_directory[0]=C01FA100, fe_directory[1]=C0FFCB80
   # 0029 4 000e fffe fffe 000c Dv 2:0:0 PUB c0488228 Type 00  Pub st    6 ri  0
 BLOX: vaso 35556389, vabbro 35556389, vafediro 35556391, vafeo 35556394
vaconfo 35565077, vaid1 35565078, vsilbnsiz 35556389, vsicontsiz 0  mdatav 11,
nodest 0, prev_online 0, size_val 1, id0_gd 0, id1_gd 0, save_c 0, parted 1,
sc-dis 0 fe_directory[0]=C01FA100, fe_directory[1]=C0FFCB80
   # 000c 4 000e fffe fffe 001a Dv 3:1:0 PUB c0487e80 Type 00  Pub st    6 ri  1
 BLOX: vaso 17769177, vabbro 17769177, vafediro 17769179, vafeo 17769181
vaconfo 17773521, vaid1 17773522, vsilbnsiz 17769177, vsicontsiz 0  mdatav 11,
nodest 0, prev_online 0, size_val 1, id0_gd 0, id1_gd 0, save_c 0, parted 1,
sc-dis 0 fe_directory[0]=C01FA100, fe_directory[1]=C0FFCB80
```

```
# 001a 4 000e fffe fffe fffe Dv 5:1:0 PUB c0487cac Type 00  Pub st    6 ri  3
 BLOX: vaso 17769177, vabbro 17769177, vafediro 17769179, vafeo 17769181  vaconfo
17773521, vaid1 17773522, vsilbnsiz 17769177, vsicontsiz 0  mdatav 11, nodest 0,
prev_online 0, size_val 1, id0_gd 0, id1_gd 0, save_c 0, parted 1, sc-dis 0
fe_directory[0]=C01FA100, fe_directory[1]=C0FFCB80

     Nv  St  Up   Us   Dn   Ds
-------------------------------
#### 0028 4 fffe 0027 0022 fffe Un D10   U
#### 0027 4 fffe 0025 0022 fffe Un D9    U
#### 0025 4 fffe 0024 0022 fffe Un D8    U
#### 0024 4 fffe 0023 0022 fffe Un D7    U
#### 0023 4 fffe fffe 0022 fffe Un D6    U
 ### 0022 4 0028 fffe 0011 fffe St      RS
   # 0011 4 0022 fffe fffe 0017 Dv 1:2:0 P
 BLOX: vaso 17769177, vabbro 17769177, vaf
17773521, vaid1 17773522, vsilbnsiz 177691
vsicontsiz 0  mdatav 11, nodest 0, prev_on
save_c 0, parted 1, sc-dis 0 fe_directory[
   # 0017 4 0022 fffe fffe 001b Dv 3:2:0 P
 BLOX: vaso 17769177, vabbro 17769177, vaf
17773521, vaid1 17773522, vsilbnsiz 177691
vsicontsiz 0  mdatav 11, nodest 0, prev_on
save_c 0, parted 1, sc-dis 0 fe_directory[
   # 001b 4 0022 fffe fffe fffe Dv 5:2:0 P
 BLOX: vaso 17769177, vabbro 17769177, vaf
17773521, vaid1 17773522, vsilbnsiz 177691
vsicontsiz 0  mdatav 11, nodest 0, prev_on
save_c 0, parted 1, sc-dis 0 fe_directory[

     Nv  St  Up   Us   Dn   Ds
-------------------------------
#### 0030 1 fffe 002f 002a fffe Un D150  U
#### 002f 1 fffe 002e 002a fffe Un D140  U
#### 002e 1 fffe 002d 002a fffe Un D130  U
#### 002d 1 fffe 002b 002a fffe Un D120  U
#### 002b 1 fffe fffe 002a fffe Un D110  U
 ### 002a 1 0030 fffe 0012 fffe St      RS
   # 0012 1 002a fffe fffe 0018 Dv 1:3:0 P
 BLOX: vaso 17769177, vabbro 17769177, vaf
17773521, vaid1 17773522, vsilbnsiz 177691
vsicontsiz 0  mdatav 11, nodest 0, prev_on
save_c 0, parted 1, sc-dis 0 fe_directory[
   # 0018 1 002a fffe fffe 001c Dv 3:3:0 P
 BLOX: vaso 17769177, vabbro 17769177, vaf
17773521, vaid1 17773522, vsilbnsiz 177691
vsicontsiz 0  mdatav 11, nodest 0, prev_on
save_c 0, parted 1, sc-dis 0 fe_directory[
   # 001c 1 002a fffe fffe fffe Dv 5:3:0 P
 BLOX: vaso 17769177, vabbro 17769177, vaf
17773521, vaid1 17773522, vsilbnsiz 177691
 vsicontsiz 0  mdatav 11, nodest 0, prev_or
save_c 0, parted 1, sc-dis 0 fe_directory[

     Nv  St  Up   Us   Dn   Ds
-------------------------------
#### 0036 1 fffe 0035 0031 fffe Un D199  U
#### 0035 1 fffe 0034 0031 fffe Un D190  U
#### 0034 1 fffe 0033 0031 fffe Un D180  U
#### 0033 1 fffe 0032 0031 fffe Un D170  U
#### 0032 1 fffe fffe 0031 fffe Un D160  U
 ### 0031 1 0036 fffe 0013 fffe St      RS
   # 0013 1 0031 fffe fffe 0019 Dv 1:4:0 P
```

```
BLOX: vaso 17769177, vabbro 17769177, vafediro 17769179, vafeo 17769181  vaconfo
17773521, vaid1 17773522, vsilbnsiz 17769177,
vsicontsiz 0  mdatav 11, nodest 0, prev_online 0, size_val 1, id0_gd 1, id1_gd
1, save_c 0, parted 1, sc-dis 0 fe_directory[0]=627FFE00,
fe_directory[1]=62806200
   # 0019 1 0031 fffe fffe 001d Dv 3:4:0 PUB c0486e0c Type 00  Pub st    5 ri  1
 BLOX: vaso 17769153, vabbro 17769153, vafediro 17769155, vafeo 17769157
vaconfo 17773497, vaid1 17773498, vsilbnsiz 17769153,
vsicontsiz 0  mdatav 11, nodest 0, prev_online 0, size_val 1, id0_gd 1, id1_gd
1, save_c 0, parted 1, sc-dis 0 fe_directory[0]=62806600,
fe_directory[1]=62806A00
   # 001d 1 0031 fffe fffe fffe Dv 5:4:0 PUB c0486c38 Type 00  Pub st    5 ri  2
 BLOX: vaso 17769177, vabbro 17769177, vafediro 17769179, vafeo 17769181
vaconfo 17773521, vaid1 17773522, vsilbnsiz 17769177,
 vsicontsiz 0  mdatav 11, nodest 0, prev_online 0, size_val 1, id0_gd 1, id1_gd
1, save_c 0, parted 1, sc-dis 0 fe_directory[0]=62806E00,
fe_directory[1]=62807200

     Nv  St  Up   Us   Dn   Ds
-------------------------------
  ## 0008 3 fffe fffe fffe fffe Failedset

     Nv  St  Up   Us   Dn   Ds
-------------------------------
  ## 0009 3 fffe fffe fffe fffe Spareset

     Nv  St  Up   Us   Dn   Ds
-------------------------------
   # 0014 2 fffe fffe fffe fffe Dv 1:5:0 PUB c0486a64 Type 00  Pub st    6
 BLOX: vaso 17769177, vabbro 17769177, vafediro 17769179, vafeo 17769181
vaconfo 17773521, vaid1 17773522, vsilbnsiz 17769177,
vsicontsiz 0  mdatav 11, nodest 0, prev_online 0, size_val 1, id0_gd 0, id1_gd
0, save_c 0, parted 0, sc-dis 0 fe_directory[0]=C01FA100,
fe_directory[1]=C0FFCB80

     Nv  St  Up   Us   Dn   Ds
-------------------------------
   # 0015 2 fffe fffe fffe fffe Dv 1:8:0 PUB c04864e8 Type 00  Pub st    6
 BLOX: vaso 17769177, vabbro 17769177, vafediro 17769179, vafeo 17769181
vaconfo 17773521, vaid1 17773522, vsilbnsiz 17769177,
vsicontsiz 0  mdatav 11, nodest 0, prev_online 0, size_val 1, id0_gd 0, id1_gd
0, save_c 0, parted 0, sc-dis 0 fe_directory[0]=C01FA100,
fe_directory[1]=C0FFCB80

     Nv  St  Up   Us   Dn   Ds
-------------------------------
   # 0016 2 fffe fffe fffe fffe Dv 3:0:0 PUB c04883fc Type 00  Pub st    6
 BLOX: vaso 71114623, vabbro 71114623, vafediro 71114625, vafeo 71114630
vaconfo 71131997, vaid1 71131998, vsilbnsiz 71114623,
vsicontsiz 0  mdatav 11, nodest 0, prev_online 0, size_val 1, id0_gd 0, id1_gd
0, save_c 0, parted 0, sc-dis 0 fe_directory[0]=C01FA100,
fe_directory[1]=C0FFCB80
Nv  St  Up   Us   Dn   Ds
-------------------------------
   # 001e 2 fffe fffe fffe fffe Dv 5:5:0 PUB c0486890 Type 00  Pub st    6
 BLOX: vaso 17769177, vabbro 17769177, vafediro 17769179, vafeo 17769181
vaconfo 17773521, vaid1 17773522, vsilbnsiz 17769177,
vsicontsiz 0  mdatav 11, nodest 0, prev_online 0, size_val 1, id0_gd 0, id1_gd
0, save_c 0, parted 0, sc-dis 0 fe_directory[0]=C01FA100,
fe_directory[1]=C0FFCB80
```

```
Nv  St  Up   Us   Dn   Ds
-------------------------------
   # 0026 2 fffe fffe fffe fffe Dv 5:8:0 PUB c0486314 Type 00  Pub st    6
 BLOX: vaso 17769177, vabbro 17769177, vafediro 17769179, vafeo 17769181  vaconfo
17773521, vaid1 17773522, vsilbnsiz 17769177,
vsicontsiz 0  mdatav 11, nodest 0, prev_online
save_c 0, parted 0, sc-dis 0 fe_directory[0]=(

     Nv  St  Up   Us   Dn   Ds
-------------------------------
   # 002c 2 fffe fffe fffe fffe Dv 3:5:0 PUB (
 BLOX: vaso 17769177, vabbro 17769177, vafedir
17773521, vaid1 17773522, vsilbnsiz 17769177,
vsicontsiz 0  mdatav 11, nodest 0, prev_online
save_c 0, parted 0, sc-dis 0 fe_directory[0]=(

*********************************************
        Information of all devices in full (SI
*********************************************

Name          Type                      Port
---------------------------------------------

DISK10100     disk                         1
          COMPAQ   BD009122BA       3B08
        Switches:
          NOTRANSPORTABLE
          TRANSFER_RATE_REQUESTED = 20MHZ (sy
        Size:            17769177 blocks
        V- 11 Configuration NOT being backed
DISK10200     disk                         1
          COMPAQ   BD00962373       BCJE
        Switches:
          NOTRANSPORTABLE
          TRANSFER_RATE_REQUESTED = 20MHZ (sy
        Size:            17769177 blocks
        V- 11 Configuration NOT being backed
DISK10300     disk                         1
          COMPAQ   BD00962373       BCJ9
        Switches:
          NOTRANSPORTABLE
          TRANSFER_RATE_REQUESTED = 20MHZ (sy
        Size:            17769177 blocks
        V- 11 Configuration NOT being backed
DISK10400     disk                         1
          COMPAQ   BD009122BA       3B08
        Switches:
          NOTRANSPORTABLE
          TRANSFER_RATE_REQUESTED = 20MHZ (sy
        Size:            17769177 blocks
        V- 11 Configuration NOT being backed
DISK10500     disk                         1
          COMPAQ   BD009122BA       3B08
        Switches:
          NOTRANSPORTABLE
          TRANSFER_RATE_REQUESTED = 20MHZ (sy
        Size:            17769177 blocks
        V- 11 Configuration NOT being backed
```

```
DISK10800     disk                         1    8    0
          COMPAQ   BD009122BA       3B08
        Switches:
          NOTRANSPORTABLE
          TRANSFER_RATE_REQUESTED = 20MHZ (synchronous 20.00 MHZ negotiated)
        Size:            17769177 blocks
        V- 11 Configuration NOT being backed up on this container
DISK20000     disk                         2    0    0        S1
          COMPAQ   BD0186398C       B92J
        Switches:
          NOTRANSPORTABLE
          TRANSFER_RATE_REQUESTED = 20MHZ (synchronous 20.00 MHZ negotiated)
        Size:            35556389 blocks
        V- 11 Configuration NOT being backed up on this container
DISK30000     disk                         3    0    0
          COMPAQ   BD0366349C       3B02
        Switches:
          NOTRANSPORTABLE
          TRANSFER_RATE_REQUESTED = 20MHZ (synchronous 20.00 MHZ negotiated)
        Size:            71114623 blocks
        V- 11 Configuration NOT being backed up on this container
DISK30100     disk                         3    1    0        S1
          COMPAQ   BD009122C6       B016
        Switches:
          NOTRANSPORTABLE
          TRANSFER_RATE_REQUESTED = 20MHZ (synchronous 20.00 MHZ negotiated)
        Size:            17769177 blocks
        V- 11 Configuration NOT being backed up on this container
DISK30200     disk                         3    2    0        S2
          COMPAQ   BD009122BA       3B08
        Switches:
          NOTRANSPORTABLE
          TRANSFER_RATE_REQUESTED = 20MHZ (synchronous 20.00 MHZ negotiated)
        Size:            17769177 blocks
        V- 11 Configuration NOT being backed up on this container
DISK30300     disk                         3    3    0        S3
          COMPAQ   BD009122BA       3B07
        Switches:
          NOTRANSPORTABLE
          TRANSFER_RATE_REQUESTED = 20MHZ (synchronous 20.00 MHZ negotiated)
        Size:            17769177 blocks
        V- 11 Configuration NOT being backed up on this container
DISK50800     disk                         5    8    0
          COMPAQ   BD00962373       BCJ9
        Switches:
          NOTRANSPORTABLE
          TRANSFER_RATE_REQUESTED = 20MHZ (synchronous 20.00 MHZ negotiated)
        Size:            17769177 blocks
        V- 11 Configuration NOT being backed up on this container
BOT           logdisk                      1    0    0
          COMPAQ   AD009322C5       A019
        Size:            17773500 blocks
        Logdisk for this controller
TOP           logdisk                      5    0    0
        Logdisk for other controller
```

```
***************************************************************
       Information of all storage sets in full (SHOW STORAGE FULL).
***************************************************************

Name          Storageset                      U
---------------------------------------------

S1            stripeset                       I
                                              I
                                              I
                                              I


       Switches:
         CHUNKSIZE = 256 blocks
       State:
         NORMAL
         DISK10100 (member  0) is NORMAL
         DISK20000 (member  1) is NORMAL
         DISK30100 (member  2) is NORMAL
         DISK50100 (member  3) is NORMAL
       Size:             71076708 blocks
       Partitions:
         Partition number        Size
         -----------------------------------
           1                 14215163 (   72
           2                 14215163 (   72
           3                 14215163 (   72
           4                 14215163 (   72
           5                 14215163 (   72
                                  863 (

S2            stripeset                       I
                                              I
                                              I


       Switches:
         CHUNKSIZE = 256 blocks
       State:
         NORMAL
         DISK10200 (member  0) is NORMAL
         DISK30200 (member  1) is NORMAL
         DISK50200 (member  2) is NORMAL
       Size:             53307531 blocks
       Partitions:
         Partition number        Size
         -----------------------------------
           1                 10661371 (   54
           2                 10661371 (   54
           3                 10661371 (   54
           4                 10661371 (   54
           5                 10661371 (   54
                                  646 (
```

```
S2            stripeset                       DISK10200        D10
                                              DISK30200        D6
                                              DISK50200        D7
                                                               D8
                                                               D9
        Switches:
          CHUNKSIZE = 256 blocks
        State:
          NORMAL
          DISK10200 (member  0) is NORMAL
          DISK30200 (member  1) is NORMAL
          DISK50200 (member  2) is NORMAL
        Size:             53307531 blocks
        Partitions:
         Partition number        Size              Starting Block     Used
by

-------------------------------------------------------------------
          1                 10661371 (   5458.62 MB)            0      D6
          2                 10661371 (   5458.62 MB)     10661376      D7
          3                 10661371 (   5458.62 MB)     21322752      D8
          4                 10661371 (   5458.62 MB)     31984128      D9
          5                 10661371 (   5458.62 MB)     42645504      D10
                                  646 (      0.33 MB)     53306880
<free>

S3            stripeset                       DISK10300        D110
                                              DISK30300        D120
                                              DISK50300        D130
                                                               D140
                                                               D150
        Switches:
          CHUNKSIZE = 256 blocks
        State:
          NORMAL
          DISK10300 (member  0) is NORMAL
          DISK30300 (member  1) is NORMAL
          DISK50300 (member  2) is NORMAL
        Size:             53307531 blocks
        Partitions:
         Partition number        Size              Starting Block     Used
by

-------------------------------------------------------------------
          1                 10661371 (   5458.62 MB)            0      D110
          2                 10661371 (   5458.62 MB)     10661376      D120
          3                 10661371 (   5458.62 MB)     21322752      D130
          4                 10661371 (   5458.62 MB)     31984128      D140
          5                 10661371 (   5458.62 MB)     42645504      D150
                                  646 (      0.33 MB)     53306880
<free>
```

```
S3           stripeset                    DISK10300       D110
                                          DISK30300       D120
                                          DISK50300       D130
                                                          D140

        Switches:
          CHUNKSIZE = 256 blocks
        State:
          NORMAL
          DISK10300 (member  0) is NORMAL
          DISK30300 (member  1) is NORMAL
          DISK50300 (member  2) is NORMAL
        Size:            53307531 blocks
        Partitions:
          Partition number        Size
          ------------------------------------
            1                 10661371 (   545
            2                 10661371 (   545
            3                 10661371 (   545
            4                 10661371 (   545
            5                 10661371 (   545
                                   646 (

S4           stripeset                    D
                                          D
                                          D

        Switches:
          CHUNKSIZE = 256 blocks
        State:
          NORMAL
          DISK10400 (member  0) is NORMAL
          DISK30400 (member  1) is NORMAL
          DISK50400 (member  2) is NORMAL
        Size:            53307459 blocks
        Partitions:
          Partition number        Size
          ------------------------------------
            1                 10661371 (   545
            2                 10661371 (   545
            3                 10661371 (   545
            4                 10661371 (   545
            5                 10661371 (   545
                                   574 (

SPARESET      spareset

FAILEDSET     failedset
        Switches:
          NOAUTOSPARE
```

```
**************************************************************
        Information of all units in full (SHOW UNITS FULL).
**************************************************************

    LUN                                    Uses             Used by
------------------------------------------------------------------------------

  D1                                       S1           (partition)
        LUN ID:      6000-1FE1-0001-E200-0001-1234-5678-02B3
        IDENTIFIER = 1
        Switches:
          RUN                    NOWRITE_PROTECT        READ_CACHE
          READAHEAD_CACHE        WRITEBACK_CACHE
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to the other controller
          PREFERRED_PATH = OTHER_CONTROLLER
        Size:             14215163 blocks
        Geometry (C/H/S): ( 4206 / 20 / 169 )
        NOHOST_REDUNDANT
  D2                                       S1           (partition)
        LUN ID:      6000-1FE1-0001-E200-0001-1234-5678-02B4
        IDENTIFIER = 2
        Switches:
          RUN                    NOWRITE_PROTECT        READ_CACHE
          READAHEAD_CACHE        WRITEBACK_CACHE
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to the other controller
          PREFERRED_PATH = OTHER_CONTROLLER
        Size:             14215163 blocks
        Geometry (C/H/S): ( 4206 / 20 / 169 )
        NOHOST_REDUNDANT
  D3                                       S1           (partition)
        LUN ID:      6000-1FE1-0001-E200-0001-1234-5678-02B5
        IDENTIFIER = 3
        Switches:
          RUN                    NOWRITE_PROTECT        READ_CACHE
          READAHEAD_CACHE        WRITEBACK_CACHE
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to the other controller
          PREFERRED_PATH = OTHER_CONTROLLER
        Size:             14215163 blocks
        Geometry (C/H/S): ( 4206 / 20 / 169 )
        NOHOST_REDUNDANT
```

```
  D4                                        S1           (partition)
        LUN ID:      6000-1FE1-0001-E200-0001-1234-5678-02B6
        IDENTIFIER = 4
        Switches:
          RUN                    NOWRITE_PROTE
          READAHEAD_CACHE        WRITEBACK_CAC
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to the other controller
          PREFERRED_PATH = OTHER_CONTROLLER
        Size:             14215163 blocks
        Geometry (C/H/S): ( 4206 / 20 / 169 )
        NOHOST_REDUNDANT
    D5                                        S
        LUN ID:      6000-1FE1-0001-E200-0001-
        IDENTIFIER = 5
        Switches:
          RUN                    NOWRITE_PROTE
          READAHEAD_CACHE        WRITEBACK_CAC
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to the other controller
          PREFERRED_PATH = OTHER_CONTROLLER
        Size:             14215163 blocks
        Geometry (C/H/S): ( 4206 / 20 / 169 )
        NOHOST_REDUNDANT
    D6                                        S
        LUN ID:      6000-1FE1-0001-E200-0001-
        IDENTIFIER = 6
        Switches:
          RUN                    NOWRITE_PROTE
          READAHEAD_CACHE        WRITEBACK_CAC
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to the other controller
          PREFERRED_PATH = OTHER_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
    D7                                        S
        LUN ID:      6000-1FE1-0001-E200-0001-
        IDENTIFIER = 7
        Switches:
          RUN                    NOWRITE_PROTE
          READAHEAD_CACHE        WRITEBACK_CAC
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
```

```
  Access:
                ALL
        State:
          ONLINE to the other controller
          PREFERRED_PATH = OTHER_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
    D8                                        S2           (partition)
        LUN ID:      6000-1FE1-0001-E200-0001-1234-5678-02BF
        IDENTIFIER = 8
        Switches:
          RUN                    NOWRITE_PROTECT        READ_CACHE
          READAHEAD_CACHE        WRITEBACK_CACHE
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to the other controller
          PREFERRED_PATH = OTHER_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
    D9                                        S2           (partition)
        LUN ID:      6000-1FE1-0001-E200-0001-1234-5678-02C0
        IDENTIFIER = 9
        Switches:
          RUN                    NOWRITE_PROTECT        READ_CACHE
          READAHEAD_CACHE        WRITEBACK_CACHE
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to the other controller
          PREFERRED_PATH = OTHER_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
    D10                                       S2           (partition)
        LUN ID:      6000-1FE1-0001-E200-0001-1234-5678-02C1
        IDENTIFIER = 10
        Switches:
          RUN                    NOWRITE_PROTECT        READ_CACHE
          READAHEAD_CACHE        WRITEBACK_CACHE
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to the other controller
          PREFERRED_PATH = OTHER_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
```

```
D110                                    S3           (partition)
        LUN ID:      6000-1FE1-0001-E200-0001-1234-5678-02C7
        IDENTIFIER = 110
        Switches:
          RUN                    NOWRITE_PROT
          READAHEAD_CACHE        WRITEBACK_CA
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to this controller
          Not reserved
          PREFERRED_PATH = THIS_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
  D120
        LUN ID:      6000-1FE1-0001-E200-0001
        IDENTIFIER = 120
        Switches:
          RUN                    NOWRITE_PROT
          READAHEAD_CACHE        WRITEBACK_CA
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to this controller
          Not reserved
          PREFERRED_PATH = THIS_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
  D130
        LUN ID:      6000-1FE1-0001-E200-0001
        IDENTIFIER = 130
        Switches:
          RUN                    NOWRITE_PROT
          READAHEAD_CACHE        WRITEBACK_CA
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to this controller
          Not reserved
          PREFERRED_PATH = THIS_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
D140                                    S3
        LUN ID:      6000-1FE1-0001-E200-0001
        IDENTIFIER = 140
        Switches:
          RUN                    NOWRITE_PROT
          READAHEAD_CACHE        WRITEBACK_CA
```

```
MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to this controller
          Not reserved
          PREFERRED_PATH = THIS_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
  D150                                  S3           (partition)
        LUN ID:      6000-1FE1-0001-E200-0001-1234-5678-02CB
        IDENTIFIER = 150
        Switches:
          RUN                    NOWRITE_PROTECT        READ_CACHE
          READAHEAD_CACHE        WRITEBACK_CACHE
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to this controller
          Not reserved
          PREFERRED_PATH = THIS_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
  D160                                  S4           (partition)
        LUN ID:      6000-1FE1-0001-E200-0001-1234-5678-02D1
        IDENTIFIER = 160
        Switches:
          RUN                    NOWRITE_PROTECT        READ_CACHE
          READAHEAD_CACHE        WRITEBACK_CACHE
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to this controller
          Not reserved
          PREFERRED_PATH = THIS_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
  D170                                  S4           (partition)
        LUN ID:      6000-1FE1-0001-E200-0001-1234-5678-02D2
        IDENTIFIER = 170
        Switches:
          RUN                    NOWRITE_PROTECT        READ_CACHE
          READAHEAD_CACHE        WRITEBACK_CACHE
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
```

```
State:
          ONLINE to this controller
          Not reserved
          PREFERRED_PATH = THIS_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
  D180                                           S
        LUN ID:      6000-1FE1-0001-E200-0001-
        IDENTIFIER = 180
        Switches:
          RUN                     NOWRITE_PROTE
          READAHEAD_CACHE         WRITEBACK_CAC
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to this controller
          Not reserved
          PREFERRED_PATH = THIS_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
  D190                                           S
        LUN ID:      6000-1FE1-0001-E200-0001-
        IDENTIFIER = 190
        Switches:
          RUN                     NOWRITE_PROTE
          READAHEAD_CACHE         WRITEBACK_CAC
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
          ONLINE to this controller
          Not reserved
          PREFERRED_PATH = THIS_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
  D199                                           S
        LUN ID:      6000-1FE1-0001-E200-0001-
        IDENTIFIER = 199
        Switches:
          RUN                     NOWRITE_PROTE
          READAHEAD_CACHE         WRITEBACK_CAC
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
Access:
                ALL
        State:
          ONLINE to this controller
          Not reserved
          PREFERRED_PATH = THIS_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
```

```
Access:
                ALL
        State:
          ONLINE to this controller
          Not reserved
          PREFERRED_PATH = THIS_CONTROLLER
        Size:             10661371 blocks
        Geometry (C/H/S): ( 3155 / 20 / 169 )
        NOHOST_REDUNDANT
hsg80_bot>
```

Utilities and Exercisers

2

This chapter describes the utilities and exercisers available to help troubleshoot and maintain the controllers, cache modules, and ECBs. These utilities and exercisers include:

- Fault Management Utility (FMU), page 68
- Video Terminal Display (VTDPY) utility, page 89
- Disk Inline Exerciser (DILX), page 119
- Format and device code load utility (HSUTIL), page 126
- Configuration (CONFIG) utility, page 128
- Code Load and Code Patch (CLCP) utility, page 129
- CLONE utility, page 131
- Field Replacement Utility (FRUTIL), page 132
- Change Volume Serial Number (CHVSN) utility, page 133

Fault Management Utility (FMU)

FMU provides a limited interface to the controller fault management software. Use *FMU* to:

- Display the last failure and memory-system failure entries that the fault management software stores in the controller nonvolatile memory.
- Translate many of the code values contained in event messages (for example, entries might contain code values that indicate the cause of the event, the software component that reported the event, or the repair action).
- Display the Instance Codes that identify and accompany significant events that do not cause the controller to halt operation.
- Display the Last Failure Codes that identify and accompany failure events that cause the controller to halt operations. Last Failure Codes are sent to the host only after the affected controller is restarted.
- Control the display characteristics of significant events and failures that the fault management system displays on the maintenance terminal. See "Controlling the display of significant events and failures" on page 71 for specific details on this feature.
- Display device services event silo.
- Display detailed device characteristics.

Displaying last failure entries

The controller stores the 16 most recent last failure reports as entries in its nonvolatile memory. The occurrence of any failure event halts operation of the controller on which it occurred.

Note: Memory system failures are reported through the last failure mechanism but can be displayed separately.

To display the last failure entries:

1. Connect a PC or a local terminal to the controller maintenance port.
2. Start *FMU* with the following command:

```
RUN FMU
```

3. Show one or more of the entries with the following command:

   `SHOW event_type entry# FULL`

   where:

   - *event-type* is LAST_FAILURE or MEMORY_SYSTEM_FAILURE.
   - *entry#* is ALL, MOST_RECENT, or 1 through 16.
   - *FULL* displays additional information, such as the Intel® i960 stack and hardware component register sets (for example, the memory controller, FX, host port, device ports, and so forth).

4. Exit *FMU* with the following command:

   `EXIT`

The following example shows a last failure entry. The Informational Report—the lower half of the entry—contains the Last Failure Code, reporting component, and so forth, that can be translated with *FMU* to learn more about the event.

```
Last Failure Entry: 4. Flags: 006FF300
Template: 1.(01) Description: Last Failure Event
 Occurred on 28-OCT-2004 at 15:29:28
Power On Time: 0. Years, 14. Days, 19. Hours, 51. Minutes, 31.
Seconds
Controller Model: HSG80
Serial Number: AA12345678 Hardware Version: 0000(00)
Software Version: V088P(FF)
Informational Report
Instance Code: 0102030A Description:
 An unrecoverable software inconsistency was detected or an
intentional  restart or shutdown of controller operation was
requested.
Reporting Component: 1.(01) Description:
 Executive Services
Reporting component's event number: 2.(02)
Event Threshold: 10.(0A) Classification:
 SOFT. An unexpected condition detected by a controller
software component  (e.g., protocol violations, host buffer
access errors, internal  inconsistencies, uninterpreted
device errors, etc.) or an intentional  restart or shutdown of
controller operation is indicated.
Last Failure Code: 20090010 (No Last Failure Parameters)
Last Failure Code: 20090010 Description:
 This controller requested this controller to shutdown.
Reporting Component: 32.(20) Description:
 Command Line interface
Reporting component's event number: 9.(09)
Restart Type: 1.(01) Description: No restart
```

Figure 7: Sample last failure entry

Translating event codes

To translate the event codes in the fault management reports for spontaneous events and failures:

1. Connect a PC or a local terminal to the controller maintenance port.
2. Start *FMU* with the following command:

   ```
   RUN FMU
   ```

3. Show one or more of the entries with the following command:

   DESCRIBE *code_type code#*

   where:

   - *code_type* is one of those listed in Table 12.
   - *code#* is the alphanumeric value displayed in the entry.

Table 12: Event Code Types

Item	Event Code Type
1.	ASC_ASCQ_CODE[1]
2.	COMPONENT_CODE
3.	CONTROLLER_UNIQUE_ASC_ASCQ_CODE*
4.	DEVICE_TYPE_CODE
5.	EVENT _THRESHOLD_CODE
6.	INSTANCE_CODE
7.	LAST_FAILURE_CODE
8.	REPAIR_ACTION_CODE
9.	RESTART_TYPE
10.	SCSI_COMMAND_OPERATION_CODE*
11.	SENSE_DATA_QUALIFIERS*
12.	SENSE_KEY_CODE
13.	TEMPLATE_CODE

1. Code types marked with an asterisk (*) require multiple code numbers (see the "Event Reporting Templates" chapter that starts on page 135 for types codes used in the various templates; the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161 for ASC, ASCQ, Repair Action, and Component ID Codes; the "Instance Codes" chapter that starts on page 177 for Instance Codes; and the "Last Failure Codes" chapter that starts on page 211 for Last Failure Codes).

Figure 8 shows an example of a *FMU* translation of a Last Failure Code and an Instance Code.

```
FMU>DESCRIBE LAST_FAILURE_CODE 206C0020
Last Failure Code: 206C0020
Description: Controller was forced to restart in order for new controller
code image to take effect.
Reporting Component: 32.(20)
Description: Command Line interface
Reporting component's event number: 108.(6C)
Restart Type: 2.(02)
Description: Automatic hardware restart

FMU>DESCRIBE INSTANCE 026e0001
Instance Code: 026E0001
Description: The device specified in the Device Locator field has been
reduced from the Mirrorset associated with the logical unit. The nominal
number of members in the mirrorset has been decreased by one. The reduced
device is now available for use.
Reporting Component: 2.(02)
Description: Value Added Services
Reporting component's event number: 110.(6E)
Event Threshold: 1.(01) Classification:
IMMEDIATE. Failure or potential failure of a component critical to proper
controller operation is indicated; immediate attention is required.
```

Figure 8: FMU translation of a Last Failure Code and an Instance Code Sample

Controlling the display of significant events and failures

Use the `SET` command to control how the fault management software displays significant events and failures.

Table 13 on page 72 describes the various `SET` commands that can be entered while running *FMU*. These commands remain in effect while the current *FMU* session remains active, unless the `PERMANENT` qualifier is entered (the last entry in the table).

Table 13: FMU SET Commands

Command	Result
SET EVENT_LOGGING SET NOEVENT_LOGGING	Enables and disables the spontaneous display of significant events to the local terminal; preceded by %EVL (see example in the section, "Spontaneous Event log," that starts on page 40). By default, logging is enabled (SET EVENT_LOGGING). If logging is enabled, the controller spontaneously displays information about the events on the local terminal. Spontaneous event logging is suspended during the execution of CLI commands and operation of utilities on a local terminal. Because these events are spontaneous, logs are not stored by the controller.
SET LAST_FAILURE LOGGING SET NOLAST_FAILURE LOGGING	Enables and disables the spontaneous display of last failure events; preceded by %LFL (see example in the section, "Last failure reporting," on page 39). By default, logging is enabled (SET LAST_FAILURE LOGGING). The controller spontaneously displays information relevant to the sudden termination of controller operation. In cases of automatic hardware reset (for example, power failure or pressing the controller **Reset** button), the fault LED log display is inhibited because automatic resets do not allow sufficient time to complete the log display.
SET *log_type* REPAIR_ACTION SET *log_type* NOREPAIR_ACTION	Enables and disables the inclusion of repair action information for event logging or last failure logging. By default, repair actions are not displayed for these log types (SET *log_type* NOREPAIR_ACTION). If the display of repair actions is enabled, the controller displays any of the recommended repair actions associated with the event.
SET *log_type* VERBOSE SET *log_type* NOVERBOSE	Enables and disables the automatic translation of event codes that are contained in Event logs or last failure logs. By default, this descriptive text is not displayed (SET *log_type* NOVERBOSE). See "Translating event codes" on page 70 for instructions to translate these codes manually.

Table 13: FMU SET Commands (Continued)

Command	Result
SET PROMPT SET NOPROMPT	Enables and disables the display of the CLI prompt string following the log identifier %EVL, %LFL, or %FLL. This command is useful if the CLI prompt string is used to identify the controllers in a dual-redundant configuration (refer to the CLI reference guide for instructions to set the CLI command string for a controller). If enabled, the CLI prompt can identify which controller sent the log to the local terminal. By default, the prompt is set with the SET PROMPT CLI command.
SET TIMESTAMP SET NOTIMESTAMP	Enables and disables the display of the current date and time in the first line of an event or last failure log. By default, the timestamp is set with the SET TIMESTAMP CLI command.
SET FMU_REPAIR_ACTION SET FMU_NOREPAIR_ACTION	Enables and disables the inclusion of repair actions with SHOW LAST_FAILURE and SHOW MEMORY_SYSTEM_FAILURE commands. By default, the repair actions are not shown (SET FMU_NOREPAIR_ACTION). If repair actions are enabled, the command outputs display all of the recommended repair actions associated with the Instance or Last Failure Codes used to describe an event.
SET FMU_VERBOSE SET FMU_NOVERBOSE	Enables and disables the inclusion of Instance and Last Failure Code descriptive text with SHOW LAST_FAILURE and SHOW MEMORY_SYSTEM_ FAILURE commands. By default, this descriptive text is not displayed (SET FMU_NOVERBOSE). If the descriptive text is enabled, it identifies the fields and their numeric content that comprise an event or last failure entry.
SET CLI_EVENT_REPORTING SET NOCLI_EVENT_REPORTING	Enables and disables the asynchronous errors reported at the CLI prompt (for example, *swap signals disabled* or *shelf (enclosure) has a bad power supply*); preceded by %CER (see example in the "Troubleshooting Information" chapter on page 19). By default, these errors are reported (SET CLI_EVENT_REPORTING). These errors are cleared with the CLEAR ERRORS_CLI command.

Table 13: FMU SET Commands (Continued)

Command	Result
SET FAULT_LED_LOGGING SET NOFAULT_LED_LOGGING	Enables and disables the solid fault LED Event log display on the local terminal; preceded by %FLL. By default, logging is enabled (SET FAULT_LED_LOGGING). If enabled and a solid fault pattern is displayed in the OCP LEDs, the fault pattern and its meaning are displayed on the maintenance terminal. For many of the patterns, additional information is also displayed to aid in problem diagnosis. In cases of automatic hardware reset (for example, power failure or pressing the controller **Reset** button), the fault LED log display is inhibited because automatic resets do not allow sufficient time to complete the log display.
SHOW PARAMETERS	Displays the current settings associated with the SET command.
SET *command* PERMANENT	Preserves the SET command across controller resets.

SHOW LAST ALL command

The SHOW LAST ALL command is primarily for design engineering resources who need to have a better understanding of the circumstances of a system failure. The following shows the correct syntax for issuing the SHOW LAST *FMU* command:

```
FMU> SHOW LAST param param
```

Tip: The following commands work identically:

```
FMU> SHOW LAST ALL FULL
FMU> SHOW LAST ALL
```

SHOW RESERVATION command

The `SHOW RESERVATION` command allows full visibility of the reservation and persistent reservation status and displays which connections or hosts exist for units.

This command is primarily used by service support resources to obtain a better understanding of the circumstances of a system failure.

```
FMU> SHOW RESERVATION option
```

Command variants

The following options are available for use with the `SHOW RESERVATION` command:

- *ALL*—the default variant
- *unit-number*

```
FMU> sho reservations all
Unit D0 is reserved, exclusive access to host[0] MVQ621_A0.
Unit D1 is reserved, exclusive access to host[1] MVQ621_A1.
Unit D2 is reserved, exclusive access to host[0] MVQ621_A0.
Unit D3 is reserved, exclusive access to host[1] MVQ621_A1.
Unit D4 is reserved, exclusive access to host[0] MVQ621_A0.
Unit D5 is reserved, exclusive access to host[1] MVQ621_A1.
Unit D6 is reserved, exclusive access to host[0] MVQ621_A0.
Unit D8 is reserved, exclusive access to host[0] MVQ621_A0.
Unit D7 is reserved, exclusive access to host[1] MVQ621_A1.
FMU>
FMU> sho reservations d0
Unit D0 is reserved, exclusive access to host[0] MVQ621_A0.
FMU>
FMU> sho reservations all
Unit D14 is reserved, exclusive access to host[0] MVQ621_A1.
Unit D13 is reserved, exclusive access to host[1] MVQ621_A2.
Unit D12 is reserved, exclusive access to host[1] MVQ621_A2.
Unit D11 is reserved, exclusive access to host[1] MVQ621_A2.
Unit D10 is reserved, exclusive access to host[6] MVQ622_A2.
Unit D16 is reserved, exclusive access to host[0] MVQ621_A1.
FMU>
DOPPEL_T>sho d0
    LUN                                      Uses             Used by
-----------------------------------------------------------------

D0                                         DISK20000
        LUN ID:      6000-1FE1-0014-2F50-0009-1150-0156-006F
        NOIDENTIFIER
        Switches:
          RUN                   NOWRITE_PROTECT        READ_CACHE
          READAHEAD_CACHE       WRITEBACK_CACHE
          MAX_READ_CACHED_TRANSFER_SIZE = 32
          MAX_WRITE_CACHED_TRANSFER_SIZE = 32
        Access:
                ALL
        State:
ONLINE to this controller
          Reserved
          NOPREFERRED_PATH
        Size:            17769177 blocks
        Geometry (C/H/S): ( 5258 / 20 / 169 )
        NOHOST_REDUNDANT
DOPPEL_T>
```

Figure 9: SHOW RESERVATION sample output (Microsoft® Windows® 2003 32-bit)

```
FMU> Show Reservation
 Unit D1 has a persistent reservation.
 Host[0] TDRUM00    : R
 Host[1] SHENG03    : R W
 Host[2] SHENG02    : R W
 Host[3] TDRUM02    : R
 Host[4] SHENG01    : R W
 Host[6] SHENG00    : R W

 Unit D1 is registered by Host[1] SHENG03   with key 0x3523000000000010.

 Unit D1 is registered by Host[2] SHENG02   with key 0x3523000000000010.

 Unit D1 is registered by Host[4] SHENG01   with key 0x3523000000000010.

 Unit D1 is registered by Host[6] SHENG00   with key 0x3523000000000010.

 Unit D103 has a persistent reservation.
 Host[0] TDRUM00    : R W
 Host[1] SHENG03    : R
 Host[2] SHENG02    : R
 Host[3] TDRUM02    : R W
 Host[4] SHENG01    : R
 Host[6] SHENG00    : R

 Unit D103 is registered by Host[0] TDRUM00   with key 0x0000000000010002.

 Unit D103 is registered by Host[3] TDRUM02   with key 0x0000000000010002.
```

Figure 10: SHOW RESERVATION Sample Output (HP Tru64 UNIX)

CLEAR RESERVATION command

The `CLEAR RESERVATION` command is a unit-level only command. Use it to release a reservation to a connection that no longer exists but is not cleared by the host bus adapter (HBA) or host third-party process logout (TPRLO) on that connection. You can also use the command if the unit needs to be presented to a different host, other than the one taking the reservation or holding a persistent reservation out on it.

```
FMU> CLEAR RESERVATION <unit>
```

Note: Use the `CLEAR DEVICE _ERRORS` *`unit`* command with caution. Changing or clearing reservations or persistent reservations allows any host to access a unit if the host has a connection link to the unit.

Device Information and Error Utilities

Device Information and Error Utilities provide specific system and device error information.

- The `SHOW DEVICE_INFORMATION` *`unit`* and `SHOW DEVICE_INFORMATION` *`ALL`* *FMU* commands provide information for every device in the system.
- The `SHOW DEVICE_ERRORS` and `CLEAR DEVICE_ERRORS` *`unit`* *FMU* commands capture and clear device errors, and store them in an Event log.

Note: Clear device errors from a controller only if you are moving it between different subsystems. Otherwise, the command captures potentially useful information for troubleshooting purposes.

- The `SHOW LAST ALL FULL` *FMU* command provides detailed system malfunction information.

SHOW DEVICE_INFORMATION command

The `SHOW DEVICE_INFORMATION` *`unit`* and `SHOW DEVICE_INFORMATION` *`ALL`* commands display critical device information, such as port number, target number, model ID, firmware version, model serial numbers, device flags, and metadata details (see Figure 11 and Figure 12 on page 79). This information is important to understand if you are servicing the product.

```
FMU> show device_info disk40400

 P     T     Model            FW Vers    S/N on Media            FL    Metadata
                                                                        vers/SC

 04    03    BD0096349A       3B05       3BV0BYBW00001046HRYX    3     11/U

   FL - Device Flags:

           Sum of: 1 = Advanced support; 2 = Fairness Support

   SC - Save Configuration info:

           Not present, Used, Ignored, Disabled

FMU>
```

Figure 11: SHOW DEVICE_INFO D*xxxx* sample output

```
FMU> show device_info all

 P     T     Model            FW Vers    S/N on Media              FL    Metadata
                                                                         vers/SC

 06    04    RZ1BB-CS (C)     0844       JEC8849802LX5T            0     9/D
             DEC

 02    01    AD009322C5       A019       93078715 0008             0     11/N

 02    04    BD018635C4       B012       79003718 0017             3     9/I

 06    01    RZ1BB-CS (C)     0844       JEC8825208T40G            0     11/U
             DEC

 06    03    RZ1BB-CS (C)     0844       JEC880890KC33W            0     11/U
             DEC

 06    05    RZ1BB-CS (C)     0844       JEC883640KC37H            0     11/U
             DEC

   FL - Device Flags:

            Sum of: 1 = Advanced support; 2 = Fairness Support

   SC - Save Configuration info:

            Not present, Used, Ignored, Disabled

FMU>
```

Figure 12: SHOW DEVICE_INFO ALL sample output

Table 14: Disk Device Information (Sheet 1 of 4)

Info Displayed	Description

P T	Port#, Target#.
	The controller only supports sub-LUN 00; therefore, the sub-LUN is not portrayed. For example, disk40300 would be displayed as follows:
	Example of output:
	`P   T`
	`-----`
	`04  03`

Model	Device Model ID.
	This unique drive model number is assigned by HP and written into the device firmware by the disk drive vendor. The model ID uniquely identifies the disk drive model and is the key reference identification used to determine if the device is on the list of supported disk drives. Refer to the latest release notes or contact your HP representative for a list of supported drives.
	Note: To retrieve the latest list of devices supported with HSG60 and HSG80 array controllers, go to the following link: http://h18006.www1.hp.com/products/storageworks/softwaredrivers/acs/. Select **manuals (guides, supplements, addendums, etc)** under self-help resources, and then select **HSG60, HSG80, HSJ80, HSZ80 Supported Disk Drive Matrix**.
	Example of output:
	`Model`
	`----------`
	`BD0096349A`

Table 14: Disk Device Information (Sheet 2 of 4)

Info Displayed	Description

FW Vers	Firmware Version.
	
	The version of drive firmware is part of the device inquiry string response. Each disk drive vendor specifies content of this string and the disk drive generally increments the string for each new device firmware version.
	
	Example of output:
	
	`FW`
	`Vers`
	`----`
	`3B05`

S/N on Media	Serial Number on Media.
	
	This 32-character alphanumeric string is unique to each device. If the media firmware for a device is ever greater than 32 characters, the least significant 32 characters are displayed.
	
	Example of output:
	
	`S/N`
	`media`
	`---------------------`
	`3BV0BYBW00001046HRYX`

Table 14: Disk Device Information (Sheet 3 of 4)

Info Displayed	Description

FL	Device Flags.
	The controllers interpretation of the SCSI device characteristics.
	Example of output:
	`FL`
	`---`
	`3`
	`FL - Device Flags:`
	`Sum of: 1 = Advanced support; 2 = Fairness Support`
	Advanced Support:
	Devices support certain controller advanced operations such as Automated Read Retry Enabled (ARRE). In the previous example, the value 3 denotes that the device supports advanced support and fairness.
	Fairness Support:
	Some SCSI devices support an internal functionality that establishes how it allocates and utilizes the SCSI bus. Since the SCSI bus is an unfair bus, access to the bus for data transfer is determined by the SCSI ID. ID priority is (highest to lowest) 7, 6, 5, 4, 3, 2, 1, 0, 15, 14, 13, 12, 11, 10, 9, 8.
	A SCSI device that supports its own fairness algorithm automatically detects its own priority and the activity on the SCSI bus, and then makes adjustments to establish fairer access to the SCSI bus for lower priority devices.
	In the previous example, the value 3 denotes that the device does support SCSI-3 Fairness and the Advanced Support. If the device did *not* support SCSI-3 fairness the value displayed would be 1 (advanced support).

Table 14: Disk Device Information (Sheet 4 of 4)

Info Displayed	Description

Metadata Version/SC	Disk Container Metadata Version and Status of *SAVE_CONFIGURATION*.
	If a disk drive is introduced to a controller, and it is not initialized in Transparent Failover mode (refer to CLI reference guide), it is assigned a metadata version number. The disk drive keeps its assigned metadata version number until it is re-initialized with a version of ACS that implements a different version number.
	Example of output:
	`Metadata`
	`vers/SC`
	`--------`
	`11/*`
	* SC status (I, U, N, D)
	The SC status field is a value that indicates the *SAVE_CONFIGURATION* status on the Device (refer to CLI reference guide). The returned values are described below:
	■ Ignored—The configuration data is *not* being used nor updated for the following reasons:
	— The last initialization was previously initialized by an older version of ACS with the *SAVE_CONFIGURATION* command.
	— Incorrect version of the device metadata under which the *SAVE_CONFIGURATION* command was invoked in addition to the firmware. The version for the metadata is indicated as <11.
	■ Used—The device is currently being used as a repository of configuration information because it was initialized with the *SAVE_CONFIGURATION* command under a version of ACS that is compatible with V8.8 firmware. The metadata version is 11.
	■ Not Present—The device is not initialized or is initialized without the *SAVE_CONFIGURATION* command.
	■ Disabled—The device *SAVE_CONFIGURATION* space has been disabled by the `REINITIALIZE` *raidset TURNSAVEOFF* command.

SHOW DEVICE_ERRORS and CLEAR DEVICE_ERRORS unit command

SHOW DEVICE_ERRORS command

The SHOW DEVICE_ERRORS command captures disk device events and stores a log of events in the controller non-volatile memory (NVMEM). Because each controller stores its own events, each controller log has different entries. As you look for device errors, examine the device error log for each controller. Entries in the log do not always indicate an error. Even *healthy* drives have logged events.

```
FMU> sho device_errors


   955 events seen, 232 available
   DSEVT:22-JUN-2004 15:04:28, P/T:2/ 0, DWD:yes, Init DWD:yes,
       DS_EVENT_UA,
       opc:1A, deferred:no, sk:05, asc:24, ascq:00,
       info valid:no, info:x00000000, sks:x000200C0
   DSEVT:22-JUN-2004 15:04:28, P/T:2/ 0, DWD:yes, Init DWD:yes,
       DS_EVENT_PORT_STATUS, LEVEL2_SOFT_INT dsps:x0000000E
   DSEVT:22-JUN-2004 15:04:28, P/T:2/ 3, DWD:yes, Init DWD:yes,
       DS_EVENT_UA,
       opc:00, deferred:no, sk:06, asc:29, ascq:00,
       info valid:no, info:x00000000, sks:x00000000
   DSEVT:22-JUN-2004 15:04:28, P/T:3/ 2, DWD:yes, Init DWD:yes,
       DS_EVENT_UA,
       opc:1A, deferred:no, sk:05, asc:24, ascq:00,
       info valid:no, info:x00000000, sks:x000200C0
   DSEVT:22-JUN-2004 15:04:28, P/T:3/ 2, DWD:yes, Init DWD:yes,
       DS_EVENT_PORT_STATUS, LEVEL2_SOFT_INT dsps:x0000000E
   DSEVT:22-JUN-2004 15:04:27, P/T:4/ 2, DWD:yes, Init DWD:yes,
       DS_EVENT_UA,
   DSEVT:17-JUN-2004 09:52:51, P/T:6/ 3, DWD:yes, Init DWD:no,
       DS_EVENT_UA,
       opc:2A, deferred:no, sk:07, asc:27, ascq:00,
       info valid:yes, info:xFE0F0000, sks:x00000000
```

Figure 13: SHOW DEVICE_ERRORS sample output

Interpreting Event log fields

The Event log is listed in reverse chronological order, from most recent to oldest entry. Each event starts with DSEVT followed by the controller date and time of the event. Figure 14 explains the information in the Event log.

```
955 events seen, 232 available
DSEVT:22-JUN-2004 15:04:28, P/T:2/ 0, DWD:yes, Init DWD:yes,
    DS_EVENT_UA,
    opc:1A, deferred:no, sk:05, asc:24, ascq:00,
    info valid:no, info:x00000000, sks:x000200C0
```

Figure 14: Event log interpretation

Table 15: Event log interpretation legend

Item	Description
❶	Number of logging events that have occurred since the log was last cleared.
❷	Number of event buffers (total).
❸	Device SCSI port and target ID.
❹	For internal HP use. If Init DWD equals yes, the failed command involves device configuration following a bus reset or controller restart.
❺	Logged event code (see the "Common event descriptions" section on page 87).
❻	Variable fields depending on the event code. Possible values are: ■ opc—SCSI OpCode for the command being executed at the time of the event. Common OpCodes include: — 08, 28: Read commands — 0A, 2A: Write commands — 12: Inquiry command — 00: Test unit ready — 15, 1A: Mode sense or mode select — 25: Read capacity ■ sk—SCSI sense key from a request command as defined by SCSI. ■ ASC, ASCQ—Additional Sense Code and Additional Sense Code Qualifier, as defined by SCSI. ■ info valid—Whether the following info field has valid data. ■ sks—Data returned by the device, specific to the sense key returned.

Common event descriptions

Table 16 contains descriptions for common events.

Table 16: Common Event Descriptions

Event	Description
DS_EVENT_PORT_STATUS	A general event not decoded to more detail. This does not always indicate a problem but may be relevant in relation to other events.
DS_EVENT_SCSI_ERROR	A general event not decoded to more detail. This does not always indicate a problem but may be relevant in relation to other events.
DS_EVENT_INTERNAL_BUS_RESET	The controller reset the SCSI bus as part of error recovery, usually in response to a preceding event. It is normal to see a series of DS_EVENT_UA, sk:06, asc:29, ascq:02 on each device on that port following a bus reset.
DS_EVENT_EXTERNAL_BUS_RESET	The controller detected an external SCSI bus reset. The error should only come from the “other controller.” There should be a corresponding DS_EVENT_INTERNAL_BUS_RESET on the “other controller.” It is normal to see DS_EVENT_UA, sk:06, asc:29, ascq:02 on each device on that port following a bus reset.
DS_EVENT_BUS_PARITY_ERROR	A parity error on the SCSI bus was detected. This may indicate cabling, drive, or controller problems.
DS_EVENT_TARGET_STATUS	A device returned an error status, not detailed by a more specific event code.
DS_EVENT_SN_CHANGE	Not currently used.
DS_EVENT_BDR	Not currently used.
DS_EVENT_SEL_TO	The indicated device failed to respond. Look for missing or broken device, cabling problems, or failed controller.
DS_EVENT_BUS_TIMEOUT	A device operating on the bus failed to complete its transaction in the allotted time. This may indicate a device error, cabling problems, or controller problem. This is a rare incident and probably not of concern, because the operation is retried.
DS_EVENT_RS_ERROR	Not currently used.
DS_EVENT_COMMAND_STATUS	A device returned an error status, not detailed by a more specific event code.
DS_EVENT_BUSY	A device reported that it was busy and not able to accept the command at that time. The command is retried. This is a rare incident and is probably not of concern.

Table 16: Common Event Descriptions (Continued)

Event	Description
DS_EVENT_UA	The command completed with an error, detailed by the sense key, ASC, and ASCQ. **Note:** It is normal to see a series of DS_EVENT_UA, sk:06, asc:29, ascq:02 on each device on that port following a bus reset. **Note:** It is normal to see DS_EVENT_UA entries with a code sk:05, asc:24, ascq:00, depending on the support level of the drives in the system. These events are in response to the controller trying to set features not available on all drives. The response does not indicate a problem or reduced functionality of the storage system.
DS_EVENT_CMD_TIMEOUT	A device did not complete a request in the controller-defined time limit. The command is aborted and retried. A large number of occurrences of this event may indicate bus saturation or a device that is slow responding to commands.
DS_EVENT_BBR	Not currently used.

CLEAR DEVICE_ERRORS unit command

The `CLEAR DEVICE _ERRORS` *unit FMU* command is used:

- To delete and reinitialize "this controller" silo.

Note: HP does not recommend clearing this event silo.

Video Terminal Display (VTDPY) utility

The *VTDPY* utility, through various screens, displays configuration and performance information for HSG60 and HSG80 storage subsystems, and is used to check the subsystem for communication problems. Information displayed includes:

- Processor utilization.
- Virtual storage unit activity and configuration.
- Cache performance.
- Device activity and configuration.
- Host port activity and configuration.
- Local and remote controller activity in an HP StorageWorks Data Replication Manager configuration.

Note: All *VTDPY* screen displays are 132 characters wide. However, for readability purposes, the sample screens in this section are not complete screens as viewed on the terminal.

VTDPY Restrictions

The following are *VTDPY* restrictions:

- The *VTDPY* utility requires a serial maintenance terminal that supports ANSI control sequences or a graphics display that emulates an ANSI-compatible terminal.
- Only one *VTDPY* session can be run on a controller at a time.
- *VTDPY* does not display information for passthrough devices.

Running VTDPY

To run *VTDPY*:

1. Connect a serial maintenance terminal to the controller maintenance port.

Note: The terminal must support ANSI control sequences.

---

2. Set the terminal to Nowrap mode to prevent the top line of the display from scrolling off of the screen.
3. Press **Enter** or **Return** to display the CLI prompt.
4. Start *VTDPY* with the following command:

```
RUN VTDPY
```

Use the key sequences and commands listed in Table 17 to control *VTDPY*.

Table 17: VTDPY Key Sequences and Commands

Command	Action
Ctrl+C	Enables Command mode; after entering **Ctrl+C**, enter one of the following commands, and press **Enter** or **Return**: ■ `CLEAR` ■ `DISPLAY CACHE` ■ `DISPLAY DEFAULT` ■ `DISPLAY DEVICE` ■ `DISPLAY HOST` ■ `DISPLAY REMOTE` (ACS V8.8P only) ■ `DISPLAY RESOURCE` ■ `DISPLAY STATUS` ■ `EXIT or QUIT` ■ `HELP` ■ `INTERVAL` *`seconds`* (to change update interval) ■ `REFRESH` or `UPDATE`
Ctrl+G	Updates screen.
Ctrl+O	Pauses (and resumes) screen updates.
Ctrl+R	Refreshes the current screen display.
Ctrl+W	Refreshes the current screen display.
Ctrl+Y	Exits *VTDPY*.

Commands can be abbreviated to the minimum number of characters necessary to identify the command. Enter a question mark (**?**) after a partial command to see the values that can follow the supplied command.

For example, if `DISP ?` (`DISP<space>?`) is entered, the utility lists Cache, Default, and other possibilities.

Upon successfully executing a command—other than `HELP`—*VTDPY* exits Command mode. Pressing **Enter** or **Return** without a command also causes *VTDPY* to exit Command mode.

VTDPY help

Enter `HELP` at the *VTDPY* prompt (`VTDPY>`) to display information about *VTDPY* commands and keyboard shortcuts. See Figure 15.

Note: The ^ symbol denotes the **Ctrl** key on the keyboard.

```
VTDPY> HELP
Available VTDPY commands:
^C - Prompt for commands
^G or ^Z - Update screen
^O - Pause/Resume screen updates
^Y - Terminate program
^R or ^W - refresh screen
DISPLAY CACHE - Use 132 column unit caching statistics display
DISPLAY DEFAULT - Use 132 column system performance display
DISPLAY DEVICE - Use 132 column device performance display
DISPLAY HOST - Use 132 column Host Ports statistics display
DISPLAY REMOTE - Use 132 column controller status display
DISPLAY RESOURCE - Use 132 column controller status display
DISPLAY STATUS - Use 132 column controller status display
CLEAR - Clears the host port event counters
EXIT - Terminate program (same as QUIT)
INTERVAL <seconds> - Change update interval
HELP - Display this help message
REFRESH - Refresh the current display
QUIT - Terminate program (same as EXIT)
UPDATE - Update Screen Display
```

Figure 15: VTDPY commands and shortcuts generated from the HELP command

VTDPY screens

VTDPY displays storage subsystem information by using the following display screens:

- Display Default screen
- Controller Status screen
- Cache Performance screen
- Device Performance screen
- Host Ports Statistics screen
- Resource Statistics screen
- Remote Status screen

Display any of the screens by entering `DISPLAY` at the *VTDPY* prompt, followed by the screen name. For example, enter the following command at the *VTDPY* prompt:

```
DISPLAY CACHE
```

Each screen is shown in the following sections. Screen interpretations are presented following the various screens.

Display Default screen

The **Display Default** screen, shown in Figure 16 on page 93 (the display for ACS V8.8-*x*P differs slightly), consists of the following sections and subsections:

- Screen header, which includes:
  - Controller ID data
  - Subsystem performance
  - Controller uptime
- Controller and processor utilization
- Host port 1 and 2 packet data brief
- Full unit performance

```
VTDPY> DISPLAY DEFAULT

 HSG80              S/N: ZG92712820  SW: V88P  HW: E-01
                    0.0% Idle         0 KB/S           0 Rq/S                          Up: 0
                                                                                   22:10.03

Pr    Name    Stk/    Typ    Sta     CPU%    Target                Unit     ASW    KB/    Rd%
              Max                                                           C      S

0     NULL      0/           Rn       0.0              111111     D0001    x        0      0
                0                                                           a
```

Figure 16: Sample of the VTDPY default screen

Controller Status screen

The **Controller Status** screen shown in Figure 17 on page 94 consists of the following sections:

- Screen header, which includes:
  - Controller ID data
  - Subsystem performance
  - Controller uptime
- Controller or processor utilization
- Device port configuration
- Host port configuration
- Brief unit performance

Note: Figure 17 on page 94 applies to "this controller" only. To see "other controller" connections, run *VTDPY* again on the "other controller."

```
VTDPY>DISPLAY STATUS

 HSG80      S/N: ZG92712934 SW: V88P HW: E-01
   0.0% Idle    18093 KB/S    3165 Rq/S                         Up: 19  5:02:22
Pr   Name     Stk/    Typ    Sta     CPU%         Unit   AS    KB/S    Unit   ASWC    KB/S
              Max                                        WC
0    NULL       0/           Rn     100.0         D000   o^     658    D011   x  a       0
                0                                 0      a             2
                                                  D000   o^     683    D011   x  a       0
                                                  1      a             3
                                                  D000   o^     237    D011   x  a       0
                                                  2      a             4
                                                  D000   o^     237    D011   x  a       0
                                                  6      a             5
                                                  D000   o^     696    D011   x  a       0
                                                  7      a             6
                                                  D000   o^    2993    D011   x  a       0
                                                  8      a             7
                                                  D000   o^    2351
                                                  9      a
                                                  D001   o^    2830
```

Figure 17: Sample of the Controller Status screen

Cache Performance screen

The **Cache Performance** screen, shown in Figure 18, consists of the following sections:

- Screen header, which includes:
  - Controller ID data
  - Subsystem performance
  - Controller uptime
- Unit status
- Unit I/O activity

```
VTDPY>DISPLAY CACHE

HSG80               S/N: ZG92712820   SW: V88P-0   HW: E-01
     58.1% Idle      878 KB/S      787 Rq/S                 Up: 0  22:10:28
Unit    ASWC      KB/S    Rd   Wr%     Cm    Ht    Ph    MS   Purge   BlChd   BlHit
                           %            %     %     %     %
P0300   o            0           0                                0       0       0
                           0            0     0     0     0
D0303   o^ b         0           0                                0       0       0
                           0            0     0     0     0
D0304                0           0                                0       0       0
                           0            0     0     0     0
P0400                0           0                                0       0       0
                           0            0     0     0     0
P0401                0           0                                0       0       0
                           0            0     0     0     0
D0402   x^ b         0           0                                0       0       0
                           0            0     0     0     0
```

Figure 18: Sample of the Cache Performance screen

Device Performance screen

The **Device Performance** screen shown in Figure 19 on page 97 consists of the following sections:

- Screen header, which includes:
  - — Controller ID data
  - — Subsystem performance
  - — Controller uptime
- Device port configuration (upper left)
- Device performance (upper right)
- Device port performance (lower left)

```
VTDPY>DISPLAY DEVICE
HSG80                 S/N: ZG92712820  SW: V88P-0  HW: E-01
                      99.9% Idle      0 KB/S      0 Rq/S                 Up: 0 22:08:2
       Target                     P TL    ASWF     Rq/S   RdKB/S   WrKB/S   Que   Tg   BR   E
            111111               P1120    A^          0        0        0     0    0    0
  0123456789012345               D1130    A^          0        0        0     0    0    0
P1       hH     PDD              D1140    A^          0        0        0     0    0    0
o2       hH     DDD              D2120    A^          0        0        0     0    0    0
r3   ????hH                      D2130    A^          0        0        0     0    0    0
t4       hH DDD                  D2140    a^          0        0        0     0    0    0
 5   P   hH                      ?3020     ^ F        0        0        0     0    0    0
 6D      hH                      ?3030     ^ F        0        0        0     0    0    0
                                 ?3040     ^ F        0        0        0     0    0    0
                                 ?3050     ^ F        0        0        0     0    0    0
                                 D4090    A^          0        0        0     0    0    0
                                 D4100    A^          0        0        0     0    0    0
                                 D4110    A^          0        0        0     0    0    0
                                 P5030    A^          0        0        0     0    0    0
                                 D6010    A^          0        0        0     0    0    0

 Port        Rq/S   RdKB/S   WrKB/S     CR      BR      TR
   1            0        0        0      0       0       0
   2            0        0        0      0       0       0
   3            0        0        0      0       0       0
   4            0        0        0      0       0       0
   5            0        0        0      0       0       0
   6            0        0        0      0       0       0
```

Figure 19: Sample of regions on the Device Performance screen

Host Ports Statistics screen

The **Host Ports Statistics** screen shown in Figure 20 on page 99 consists of the following sections:

- Screen header, which includes:
  - Controller ID data
  - Subsystem performance
  - Controller uptime
- Known hosts
- Host port 1 configuration and link error counters
- Host port 2 configuration and link error counters

Note: Figure 20 on page 99 applies to “this controller” only. To see “other controller” connections, run *VTDPY* again on the “other controller.”

```
VTDPY>DISPLAY HOST
                           FIBRE CHANNEL HOST STATUS DISPLAY
    ********* KNOWN HOSTS **********      ****** PORT 1 ******    ****** PORT 2 ******
##  NAME        BB   FrSz  ID/ALPA  P S  Topology       : FAB    Topology       : FAB
                                                          RIC                     RIC
00  BONK2P2      7   2048   210113  2 N  Current        : FAB    Current        : FAB
                                         Status           RIC    Status           RIC
10  !NEWCON35    7   2048   210213  2 N  Current        : 210    Current        : 210
                                         ID/ALPA          313    ID/ALPA          413
11  DADRA11      7   2048   210213  1 N  Tachyon        :  ff    Tachyon        :  ff
                                         Status                  Status
12  BONK1P1      7   2048   210113  1 N  Queue Depth    :   6    Queue Depth    :   0
                                         Busy/QFull     :   0    Busy/QFull     :   0
                                         Rsp                     Rsp
                                         LINK ERROR COUNTERS     LINK ERROR COUNTERS
                                         Link Downs     :   1    Link Downs     :   1
                                         Soft Inits     :   0    Soft Inits     :   0
                                         Hard Inits     :   0    Hard Inits     :   0
                                         Loss of        :   0    Loss of        :   0
                                         Signals                 Signals
                                         Bad Rx Chars   :   3    Bad Rx Chars   :   3
                                         Loss of Syncs  :   0    Loss of Syncs  :   0
                                         Link Fails     :   0    Link Fails     :   0
                                         Received       :   0    Received       :   0
                                         EOFa                    EOFa
                                         Generated      :   0    Generated      :   0
                                         EOFa                    EOFa
                                         Bad CRCs       :   0    Bad CRCs       :   0
                                         Protocol       :   0    Protocol       :   0
                                         Errors                  Errors
                                         Elastic        :   0    Elastic        :   1
                                         Errors                  Errors
                                         Sfs Buff           0    Sfs Buff           0
                                         Warns                   Warns
```

Figure 20: Sample of the Host Ports Statistics screen

Resource Statistics screen

The **Resource Statistics** screen shown in Figure 21 on page 101 consists of the following sections:

- Screen header, which includes:
  - Controller ID data
  - Subsystem performance
  - Controller uptime
- Physical resource name fields
- Cache memory requirement fields (Free, Need, and Wait)
- Full unit performance
- Resource status fields (Wait Flush, wait FX, Nodes, Dirty, and Flush)

```
HSG80             S/N: ZG12345678 SW: V88F HW: 00-00
                       100.0% Idle       0 KB/S       0 Rq/S

 Resource Name    Free  Need Wait
Unit  ASWC  KB/S

---------------  ------ ---- ----

Buffers          491218    0    0

VAXDs               352    0    0

WARPs                80    0    0

RMDs                186    0    0

XBUFs               796    0    0

ZBUFs                 0    0    0

Disk Read DWDs      300    0    0

Disk Write DWDs     216    0    0

DPCX Read DWDs      144    0    0

DPCX Write DWDs     144    0    0

DDs                 252    0    0

BDBs              32456    0    0

HTBs             255 255

Pool             174096 174400

LsdbQ            1406

Wait Flush:      0 (DDs)         0 (blocks)

Wait FX:         0 (wait)        0 (queue)

Nodes:      ****** (cache)  ****** (strip)

Dirty:           0 (blocks)      0 (nodes)

Flush:           0 (blocks)      0 (nodes)
```

Figure 21: Sample of the VTDPY Resource Statistics screen

Remote Status screen

The **Remote Status** screen (ACS V8.8P only) shown in Figure 22 consists of the following sections:

- Remote copy set name
- Runtime status

```
VTDPY>DISPLAY REMOTE

COPY SET   TARGET          C  INIT     U   Kb/S   ASSOC SET   LOG    U  Kb/S    LS   %LOG    %MRG    %CPY
========   ==========      =  ====     =   ====   ========    ===    =  ====    ==   ===     ====    ====
RCS2       G213_TAR/D52    D  D2       o  920     ASC1        D98    o  ****    LG   67%     0%      100%
RCS3       G213_TAR/D0     D  D3       x  *****   ASC2        D99    x  ****    **   ***%    ***%    ***%
RCS4       G213_TAR/D0     D  D4       x  *****   ASC3        D97    x  ****    **   ***%    ***%    ***%
RCS5       NO TARGETS      *  D5       x  *****   ********    ***    x  ****    **   ***%    ***%    ***%
RCS7       G213_TAR/D57    D  D7       o  714     ASC4        D96    o  336     LG   49%     0%      100%
RCS8       G213_TAR/D0     D  D8       x  *****   ASC2        D99    x  ****    **   ***%    ***%    ***%
```

Figure 22: Sample of the VTDPY Remote Status screen (ACS V8.8P only)

Interpreting VTDPY screen information

The *VTDPY* screens display information in the following screen subsections:

- Screen header
- Common data fields
- Unit Performance data fields
- Device Performance data fields
- Device Port Performance data fields
- Host port configuration
- TACHYON chip status
- Runtime Status of Remote Copy Sets screen
- Device port configuration
- Controller and processor utilization
- Resource performance statistics

These screens are described in the following subsections. See sample *VTDPY* screens in the previous section as you review and interpret screens in this section.

Screen header

The screen header is the first line of data on every display screen. The header shows information about the overall performance of the storage subsystem and is further divided into the following four subsections:

- Controller ID data
- Subsystem performance data
- Controller uptime data
- Current date and time

The controller ID data appears as follows:

```
HSG80    S/N: xxxxxxxxxxxx    SW: xxxxxxx    HW: xx-xx
```

where:

- HSG80 (or HSG60)—Represents the controller model name and number.
- S/N—Depicts an alphanumeric serial number.
- SW—Depicts a software version number.
- HW—Depicts a hardware revision number.

The subsystem performance data appears as follows:

```
xxx.x% Idle   xxxxxx KB/S   xxxxx RQ/S
```

where:

- xxx.x% Idle—Displays the controller policy processor uptime.
- KB/s—Displays cumulative data transfer rate in kilobytes per second.
- RQ/S—Displays cumulative unit request rate in requests per second.

The controller uptime data shows the uptime of the controller in days, hours and minutes in the following format:

```
Up:   days   hh:mm:ss
```

Common data fields

Some *VTDPY* displays contain common data fields, such as the **Default**, **Status**, and **Device** screens. Table 18 provides a description of common data fields on Default and Status screens.

Table 18: VTDPY—Common Data Fields Column Definitions: Part 1

Column	Contents		
Pr	Thread priority.		
Name	Thread name or NULL (idle).		
Stk/Max	Allocated stack size in 512 byte pages and maximum number of stack pages actually used.		
Typ	Thread type:		
	FNC	=	Functional thread.
	DUP	=	Device utility and exerciser (DUP) local program threads.
Sta	Status:		
	Bl	=	Waiting for completion of a process currently running.
	Io	=	Waiting for input or output.
	Rn	=	Actively running.
CPU%	Percentage of central processing unit resource consumption.		

Other common *VTDPY* data fields in the **Default** and **Device** screens are described in Table 19 on page 105.

Table 19: VTDPY—Common Data Fields Column Definitions: Part 2

Column	Contents		
Port	SCSI ports 1 through 6.		
Target	SCSI targets 0 through 15. Single controllers occupy 7; dual-redundant controllers occupy 6 and 7.		
	D	=	Disk drive or CD-ROM drive.
	F	=	Foreign device.
	H	=	“This controller.”
	h	=	“Other controller” in dual-redundant configurations.
	P	=	Passthrough device.
	?	=	Unknown device type.
	(space)	=	No device at this port and target location.

Unit Performance data fields

VTDPY displays virtual storage unit performance information in a block of tabular data in the **Display Default**, **Controller Status**, **Cache Performance**, and **Resource Statistics** screens only. Each of these screens displays the unit performance data in a different format, as follows:

- **Display Default** screen uses the full format (see Figure 16 on page 93).
- **Controller Status** screen uses a brief format (see Figure 17 on page 94).
- **Cache Performance** screen uses the maximum format (see Figure 18 on page 95).
- **Resource Statistics** screen also uses a brief format (see Figure 21 on page 101).

Although these displays show unit performance in three different formats, the displays share common data fields, with the brief format displaying the least information, the full format supplying more information, and the maximum format displaying the maximum amount of available information. See Table 20 on page 106 for a description of each field on these screens.

Table 20: VTDPY—Unit Performance Data Fields Column Definitions

Column	Contents		
Unit	Kind of unit and unit number. Unit types include:		
	D	=	Disk drive or CD-ROM drive.
	I	=	Invisible device.
	P	=	Passthrough device.
	?	=	Unknown device type.
A	Availability of the unit:		
	a	=	Available to “other controller.”
	d	=	Offline, unit disabled for servicing.
	e	=	Online, unit mounted for exclusive access by a user.
	f	=	Offline, media format error.
	i	=	Offline, unit inoperative.
	m	=	Offline, Maintenance mode for diagnostic purposes.
	o	=	Online, host can access this unit through “this controller.”
	r	=	Offline, rundown set with the `SET NORUN` CLI command.
	v	=	Offline, no volume mounted due to lack of media.
	x	=	Online, host can access this unit through “other controller.”
	z	=	Currently not accessible to host due to a remote copy condition (ACS V8.8P only).
	(space)	=	Unknown availability.
S	State of a virtual storage unit:		
	^	=	Disk device spinning at correct speed.
	>	=	Disk device spinning up.
	<	=	Disk device spinning down.
	v	=	Disk device stopped spinning.
	(space)	=	Unknown spindle state or device is not a disk unit.
W	Write-protection state of the virtual storage device.		
	W	=	For disk drives, indicating the device is hardware write-protected.
	(space)	=	Device is not a disk unit.

Table 20: VTDPY—Unit Performance Data Fields Column Definitions (Continued)

Column	Contents		
C	Caching state of the device:		
	a	=	Read, writeback, and read-ahead caching enabled.
	b	=	Read and writeback caching enabled.
	c	=	Read and read-ahead caching enabled.
	p	=	Read-ahead caching enabled.
	r	=	Read caching only.
	w	=	Writeback caching enabled.
	space	=	Caching disabled.
Kb/s	Average amount of data transferred to and from the unit during the last update interval in kilobyte increments per second.		
Rd%	Percentage of data transferred between the host and the unit that was read from the unit.		
Wr%	Percentage of data transferred between the host and the unit that was written to the unit.		
Cm%	Percentage of data transferred between the host and the unit that was compared. A compare operation can accompany a read or a write operation, so this column is not the sum of columns `Rd%` and `Wr%`.		
Ht%	Cache-hit percentage for data transferred between the host and the unit.		
Ph%	Partial cache hit percentage of data transferred between the host and the unit.		
MS%	Cache miss percentage of data transferred between the host and the unit.		
Purge	Number of blocks purged from the writeback cache during the last update interval.		
BlChd	Number of blocks added to the cache during the last update interval.		
BlHit	Number of cached data blocks hit during the last update interval.		

Device Performance data fields

VTDPY displays up to 42 devices in the Device Performance region (see Figure 19, upper right on page 97) of the **Device** screen only. See Table 21 for a description of each field.

Table 21: VTDPY—Device Performance Data Fields Column Definitions

Column	Contents		
PTL	Type of device and the device port-target-LUN (PTL) address:		
	D	=	Disk drive.
	P	=	Passthrough device.
	?	=	Unknown device type.
	(space)	=	No device configured at this location.
A	Allocation state. Availability of the device:		
	a	=	Available to “other controller.”
	A	=	Available to “this controller.”
	u	=	Unavailable, but configured on “other controller.”
	U	=	Unavailable, but configured on “this controller.”
	(space)	=	Unknown allocation state.
S	State of the device:		
	^	=	Disk device spinning at correct speed.
	>	=	Disk device spinning up.
	<	=	Disk device spinning down.
	v	=	Disk device stopped spinning.
	(space)	=	Unknown spindle state.
W	Write-protection state of the device.		
	W	=	For disk drives, indicating the device is hardware write-protected.
	(space)	=	Other device type.
F	Fault status of a device.		
	F	=	Unrecoverable device fault. Device fault LED is on.
	(space)	=	No fault detected.

Table 21: VTDPY—Device Performance Data Fields Column Definitions (Continued)

Column	Contents
Rq/S	Average I/O request rate for the device during the last update interval. Requests can be up to 32 KB, and generated by host requests or cache flush activity.
RdKB/S	Average read data transfer rate to the device in KB/s during the previous update interval.
WrKB/S	Average write data transfer rate to the device in KB/s during the previous update interval.
Que	Maximum number of transfer requests waiting to be transferred to the device during the last screen update interval.
Tg	Maximum number of requests queued to the device during the last screen update interval. If the device does not support tagged queuing, the maximum value is 1.
BR	Number of SCSI bus resets that occurred since *VTDPY* was started.
ER	Number of SCSI errors received. If the device is swapped or deleted, then the value clears and resets to 0.

Device Port Performance data fields

VTDPY displays a Device Port Performance region (see Figure 19, lower left on page 97) on the **Device** screen only. See Table 22 for a description of each field.

Table 22: VTDPY—Device Port Performance Data Fields Column Definitions

Column	Contents
Port	SCSI device ports 1 through 6.
Rq/S	Average I/O request rate for the device during the last update interval. Requests can be up to 32 KB and generated by host requests or cache flush activity.
RdKB/S	Average read data transfer rate to the device in KB/s during the previous update interval.
WrKB/S	Average write data transfer rate to the device in KB/s during the previous update interval.
CR	Number of SCSI command resets that occurred since *VTDPY* was started.
BR	Number of SCSI bus resets that occurred since *VTDPY* was started.
TR	Number of SCSI target resets that occurred since *VTDPY* was started.

Host port configuration

VTDPY displays host port configuration information in a block of tabular data in the **Host** screen only. The data is displayed for both host port 1 and host port 2 independently, although the format is the same for both.

Use the `CLEAR` command to clear the host display link error counters.

Table 23 outlines the Known Hosts portion of the Fibre Channel Host Status display.

Table 23: Fibre Channel Host Status Display—Known Host Connections

Field Label	Description
##	Internal ID.
NAME	Refer to the `SHOW CONNECTIONS` command in CLI reference guide.
BB	Buffer-to-buffer credit.
FrSz	Frame size.
ID/ALPA	Host ID.
P	Port number (1 or 2).
S	Status:
	N = online.
	F = offline.

Table 24 and Table 25 (on page 111) detail the remaining portions of the Fibre Channel Host Status display. Table 24 includes the labels that report the status of ports 1 and 2, and Table 25 describes the link error counters.

Table 24: Fibre Channel Host Status Display—Port Status

Field Label	Description
Topology	Fabric, loop, or offline.
Current Status	Fabric, loop, down, standby, or offline.
Current ID/ALPA	Controller ID.
TACHYON Status	Denotes the current state of the TACHYON or Fibre Channel control chip. See the "TACHYON chip status" section on page 112 for more detail.

Table 24: Fibre Channel Host Status Display—Port Status (Continued)

Field Label	Description
Queue Depth	Shows the instantaneous number of commands at the controller port.
Busy/QFull Rsp	Represents the total number of QFull/Busy responses sent by the port.

Table 25: Fibre Channel Host Status Display—Link Error Counters

Field Label	Description
Link Downs	Refers to the total number of link down and up transitions.
Soft Inits	Number of loop initializations caused by this port.
Hard Inits	Indicate the number of TACHYON chip resets.
Loss of Signals	Show the number of times the *Frame Manager* detected a low-to-high transition on the `lnk_unuse` signal.
Bad Rx Chars	Represents the number of times the 8B/10B decode detected an invalid 10-bit code. FC-PH denotes this value as `Invalid Transmission Word` during frame reception. This field may be non-zero after initialization. After initialization, the host should read this value to determine the correct starting value for this error count.
Loss of Syncs	Denotes the number of times the loss of sync is greater than `RT_TOV`.
Link Fails	Indicates the number of times the *Frame Manager* detected a NOS or other initialization protocol failure that caused a transition to the Link Failure state.
Received EOFa	Refers to the number of frames containing an `EOFa` delimiter that the TACHYON chip has received.
Generated EOFa	Reveals the number of problem frames that the TACHYON chip has received that caused the *Frame Manager* to attach an `EOFa` delimiter. Frames that the TACHYON chip discarded due to internal `FIFO` overflow are not included in this or any other statistic.
Bad CRCs	Denotes the number of bad CRC frames that the TACHYON chip has received.
Protocol Errors	Indicates the number of protocol errors that the *Frame Manager* has detected.

Table 25: Fibre Channel Host Status Display—Link Error Counters (Continued)

Field Label	Description
Elastic Errors	Reveals the timing difference between the receive and transmits clocks and usually indicates cable pulls.
Sfs Buff Warns	Indicates the number of SFS buffer warning interruptions that occurred. A rapidly increasing value could indicate that the controller is running out of SFS buffer resources due to high host I/O command traffic.

TACHYON chip status

The number that appears in the TACHYON Status field represents the current state of the TACHYON or Fibre Channel control chip. It consists of a two-digit hexadecimal number, the first of which is explained in Table 26. The second digit is outlined in Table 27. Refer to the HP TACHYON user manual for a more detailed explanation of the TACHYON chip definitions.

Table 26: First Digit on the TACHYON Chip

Digit	Description	Digit	Description
0	MONITORING	8	INITIALIZING
1	ARBITRATING	9	O_I INIT FINISH
2	ARBITRATION WON	a	O_I PROTOCOL
3	OPEN	b	O_I LIP RECEIVED
4	OPENED	c	HOST CONTROL
5	XMITTED CLOSE	d	LOOP FAIL
6	RECEIVED CLOSE	f	OLD PORT
7	TRANSFER		

Table 27: Second Digit on the TACHYON Chip

Digit	Description	Digit	Description
0	OFFLINE	6	LR2
1	OL1	7	LR3
2	OL2	9	LF1
3	OL3	a	LF2
5	LR1	f	ACTIVE

Runtime Status of Remote Copy Sets screen

Use the **Runtime Status of Remote Copy Sets** screen to check the runtime status of all remote copy sets. Table 28 provides a description of the **Remote** screen column headings and possible entries under each column.

Note: This feature is only supported in the P variant of ACS.

Table 28: Remote Display Column Definitions—ACS P Variant Only

Column	Contents		
COPY SET	Remote copy set name.		
TARGET	Target connection name and target unit number.		
C	Connection status:		
	U	=	Connection up (online).
	D	=	Connection down (offline).
INIT	Initiator unit number.		
U	Availability of the unit:		
	a	=	Available to “other controller.”
	d	=	Disabled for servicing, offline.
	e	=	Mounted for exclusive access by a user.
	f	=	Media format error.
	i	=	Inoperative.
	m	=	Maintenance mode for diagnostic purposes.
	o	=	Online. Host can access this unit through “this controller.”
	r	=	Rundown with the `SET NORUN` CLI command.
	v	=	No volume mounted due to lack of media.
	x	=	Online. Host can access this unit through “other controller.”
	z	=	Currently not accessible to host due to a remote copy condition.
	(space)	=	Unknown availability.
Kb/s	Total initiator unit bandwidth in Kb per second.		
ASSOC SET	Association set name.		
U	Log unit status: uses the same codes as “U - Availability of the unit.”		
Kb/s	Total log unit bandwidth in Kb per second.		

Table 28: Remote Display Column Definitions—ACS P Variant Only (Continued)

Column	Contents		
LS	Log state:		
	LG	=	Logging.
	MG	=	Merging.
	CP	=	Copying.
	NR	=	Normal.
	NZ	=	Normalizing.
%MRG	Percentage of merge process completed.		
%CPY	Percent of copy process completed.		

Device port configuration

VTDPY displays device port configuration information in a block of tabular data in the **Default and device** screens only. The information is arranged in a grid with the port numbers listed along the vertical axis and the targets on each port listed along the horizontal axis. The word *port* is spelled out vertically to denote the port numbers. The screen shows the usage of each port and target combination with a code in the array as shown below. Field information is explained in Table 29 on page 115.

```
       Target
             111111
   123456789012345
 P1DDDD Hh
 o2DDDD Hh
 r3DDDD Hh
 t4DDDD Hh
  5DDDD Hh
  6DDDD Hh
```

Figure 23: Sample port configuration information

Table 29: Device Map Column Definitions

Column	Contents		
Port	SCSI ports 1 through 6.		
Target	SCSI targets 0 through 15. Single controllers occupy 7; dual-redundant controllers occupy 6 and 7.		
	D	=	Disk drive or CD-ROM drive.
	F	=	Foreign device.
	H	=	“This controller.”
	h	=	“Other controller” in dual-redundant configurations.
	P	=	Passthrough device.
	?	=	Unknown device type.
	(space)	=	No device at this port and target location.

Controller and processor utilization

VTDPY displays information on policy processor threads by using a block of tabular data in the **Default and Status** screens only. Thread data is located on the left side of both screens (see Figure 16 on page 93 and Figure 17 on page 94) and contains fields described in Table 30 and Table 31 on page 116.

Table 30: Controller and Processor Utilization Definitions

Column	Contents		
Pr	Thread priority. The higher the number, the higher the priority.		
Name	Thread name. For DUP Local Program threads, use the name in the Name field to invoke the program.		
Stk/Max	Allocated stack size in 512-byte pages. The Max column lists the number of stack pages actually used.		
Typ	Thread type:		
	FNC	=	Functional thread. Those threads that are started after the controller boots and never exits.
	DUP	=	DUP local program threads. Those threads that are only active while running either from a DUP connection or through the command line interface `RUN` command.
	NULL	=	A special type of thread that only executes while no other thread is executable.

Table 30: Controller and Processor Utilization Definitions (Continued)

Column	Contents		
Sta	Current thread state:		
	Bl	=	The thread is blocked waiting for timer expiration, resources, or a synchronization event.
	Io	=	A DUP local program is blocked waiting for terminal I/O completion.
	Rn	=	The thread is currently executable.
CPU%	Shows the percentage of execution time credited to each thread since the last screen update. The values might not total 100% due to rounding errors and display limitations. An unexpected amount of time can be credited to some threads because the controller firmware architecture allows code from one thread to execute in the context of another thread without a context switch.		

Table 31: *VTDPY* Thread Descriptions

Thread	Description
CLI	Local program that provides an interface to the controller command line interface thread.
CLIMAIN	Command Line Interface (CLI).
CONFIG	Local program that locates and adds devices to a configuration.
DILX	Local program that exercises disk devices.
DIRECT	Local program that returns a listing of available local programs.
DS_0	Device error recovery management thread.
DS_1	Thread that handles successful completion of physical device requests.
DS_HB	Thread that manages the device and controller error indicator lights and port **Reset** buttons.
DUART	Console terminal interface thread.
DUP	DUP protocol thread.
FMTHRD	Thread that performs error log formatting and fault reporting for the controller.
FOC	Thread that manages communication between the controllers in a dual-redundant configuration.
HP_MAIN	Host port work queue handler. Handles all work from the host port such as new I/O and completion of I/O.

Table 31: *VTDPY* Thread Descriptions (Continued)

Thread	Description
MDATA	Thread that processes metadata for nontransportable disks.
NULL	Process that is scheduled if no other process can be run.
NVFOC	Thread that initiates state change requests for the “other controller” in a dual-controller configuration.
REMOTE	Thread that manages state changes initiated by the “other controller” in a dual-controller configuration.
RMGR	Thread that manages the data buffer pool.
RECON	Thread that rebuilds the parity blocks on RAID 5 storagesets if needed and manages mirrorset copy operations if necessary.
VA	Thread that provides logical unit services, independent of the host protocol.
VTDPY	Local program that provides a dynamic display of controller configuration and performance information.

Resource performance statistics

VTDPY displays resource performance statistics by using a block of tabular data in the **Resource** screen only. Resource name and statistical data is located along the left side of the screen (see Figure 21 on page 101). Table 32 defines the resource name and statistical fields.

Table 32: Resource Performance Statistics Definitions

Column	Contents
Resource Name	Name of the physical resource.
Free	Current resources not being used.
Need	Number of resources required for the specific transaction.
Wait	Number of transactions waiting to be accomplished.
Buffers	Number of cache data buffers available for holding data.
VAXDs	Number of value-added transfer descriptors that manage the actual device I/O operations within the controller.
WARPs	Number of write algorithm request packets that manage data for RAID 5 writes.
RMDs	Number of RAID member data descriptors that manage data for RAID 5 writes.

Table 32: Resource Performance Statistics Definitions (Continued)

Column	Contents
XBUFs	Number of XOR buffers used by the FX chip for XOR operations.
ZBUFs	Number of zeroed XBUFs used by the FX chip for XOR operations.
Disk Read DWDs	Number of device work descriptors that process work requests for disk reads.
Disk Write DWDs	Number of device work descriptors that process work requests for disk writes.
DPCX Read DWDs	Number of device work descriptors that process work requests for tape reads.
DPCX Write DWDs	Number of device work descriptors that process work requests for tape writes.
DDs	Number of device work descriptors that maintain context for transfers between the host and controller.
BDBs	Data buffer descriptors.
HTBs	Host transaction blocks.
Pool	Memory pool.
Lsdbq	Large sense data buffers.
Wait Flush	Number of host write data queued for caching, pending the flushing of dirty data already cached.
Wait FX	Number of transactions waiting for the FX chip to be available.
Nodes	Number of cache nodes that are available for use.
Dirty	Amount of data buffers in cache memory that needs to be written.
Flush	Number of dirty data buffers pending flush or currently flushing from cache memory.

Disk Inline Exerciser (DILX)

Use *DILX* to check the data transfer capability of a unit (which may be composed of one or more disk drives).

Checking for unit problems

DILX generates intense read and write loads to the unit while monitoring drive performance and status. Run *DILX* on as many units as desired; however, since this utility creates substantial I/O loads on the controller, HP recommends stopping host-based I/O activity during the test.

Note: *DILX* cannot be run on Snapshot units (ACS V8.8S) or remote copy sets (ACS V8.8P only).

Finding a unit in the subsystem

To find a unit or device in the subsystem:

1. Connect a PC or a terminal to the controller maintenance port.
2. Show the devices that are configured on the controller with the following CLI command:

   `SHOW UNITS`

3. Find the specific device in the enclosure with the following CLI command:

   `LOCATE` *`unit-number`*

   This command causes the device fault LED to Flash continuously.

4. Enter the following CLI command to turn off the LED:

   `LOCATE CANCEL`

Testing the read capability of a unit

To test the read capability of a unit:

1. From a host console, dismount the logical unit that contains the unit being tested.
2. Connect a terminal to the controller maintenance port that accesses the unit being tested.

3. Run *DILX* with the following command:

   `RUN DILX`

   The system displays the following prompt: `It is recommended that` *`DILX`* `only be run when there is no host activity present on the controller. Do you want to continue (y/n)[n]?`

4. Enter **Y**(es) to accept.

Note: Use the auto configure option to test the read and write capabilities of every unit in the subsystem.

---

5. Enter **N**(o) to decline the auto configure option and to allow testing of a specific unit.
6. Enter **Y**(es) to accept the default test settings and to run the test in read-only mode.
7. Enter the unit number of the specific unit to test (for example, to test D107, enter the number 107).
8. To test more than one unit, enter the appropriate unit numbers after prompted. Otherwise, enter **N**(o) to start the test.

Note: Use the control sequences listed in Table 33 to control *DILX* during the test.

Table 33: DILX Control Sequences

Command	Action
Ctrl+C	Stops the test.
Ctrl+G	Displays the performance summary for the current test and continues testing.
Ctrl+Y	Stops the test and exits *DILX*.

Testing the read and write capabilities of a unit

Run a *DILX* Basic Function test to test the read and write capability of a unit. During the Basic Function test, *DILX* runs the following four tests:

Note: *DILX* repeats the last three tests until the time entered in step 7 on page 123 expires.

- **Write test**—Writes specific patterns of data to the unit (see Table 34). *DILX* does not repeat this test.
- **Random I/O test**—Simulates typical I/O activity by issuing read, write, access, and erase commands to randomly-chosen LBNs. The ratio of these commands can be manually set, as well as the percentage of read and write data that is compared throughout this test. This test takes 6 minutes.
- **Data-transfer test**—Tests throughput by starting at an LBN and transferring data to the next unwritten LBN. This test takes 2 minutes.
- **Seek test**—Stimulates head motion on the unit by issuing single-sector erase and access commands. Each I/O uses a different track on each subsequent transfer. The ratio of access and erase commands can be manually set. This test takes 2 minutes.

Table 34: Data Patterns for Phase 1: Write Test

Pattern	Pattern in Hexadecimal Numbers
1	0000
2	8B8B
3	3333
4	3091
5	0001, 0003, 0007, 000F, 001F, 003F, 007F, 00FF, 01FF, 03FF, 07FF, 0FFF, 1FFF, 3FFF, 7FFF
6	FIE, FFFC, FFFC, FFFC, FFE0, FFE0, FFE0, FFE0, FE00, FC00, F800, F000, F000, C000, 8000, 0000
7	0000, 0000, 0000, FFFF, FFFF, FFFF, 0000, 0000, FFFF, FFFF, 0000, FFFF, 0000, FFFF, 0000, FFFF
8	B6D9
9	5555, 5555, 5555, AAAA, AAAA, AAAA, 5555, 5555, AAAA, AAAA, 5555, AAAA, 5555, AAAA, 5555, AAAA, 5555

Table 34: Data Patterns for Phase 1: Write Test (Continued)

Pattern	Pattern in Hexadecimal Numbers
10	DB6C
11	2D2D, 2D2D, 2D2D, D2D2, D2D2, D2D2, 2D2D, 2D2D, D2D2, D2D2, 2D2D, D2D2, 2D2D, D2D2, 2D2D, D2D2
12	DB6D, B6DB, 6DB6, DB6D, B6DB, 6DB6, DB6D, B6DB, 6DB6, DB6D, B6DB, 6DB6, DB6D
13, ripple 1	0001, 0002, 0004, 0008, 0010, 0020, 0040, 0080, 0100, 0200, 0400, 0800, 1000, 2000, 4000, 8000
14, ripple 0	FIE, FFFD, FFFB, FFF7, FFEF, FFDF, FFBF, FF7F, FEFF, FDFF, FBFF, F7FF, EFFF, BFFF, DFFF, 7FFF
15	DB6D, B6DB, 6DB6, DB6D, B6DB, 6DB6, DB6D, B6DB, 6DB6, DB6D, B6DB, 6DB6, DB6D
16	3333, 3333, 3333, 1999, 9999, 9999, B6D9, B6D9, B6D9, B6D9, FFFF, FFFF, 0000, 0000, DB6C, DB6C
17	9999, 1999, 699C, E99C, 9921, 9921, 1921, 699C, 699C, 0747, 0747, 0747, 699C, E99C, 9999, 9999
18	FFFF

To test the read and write capabilities of a specific unit:

Caution: Running this test on the unit erases all data on the unit. Ensure that the units used do not contain customer data.

1. From a host console, dismount the logical unit that contains the unit to be tested.
2. Connect a terminal to the controller maintenance port that accesses the unit being tested.
3. Run *DILX* with the following command:

   ```
   RUN DILX
   ```

   The system displays the following prompt: `It is recommended that DILX only be run when there is no host activity present on the controller. Do you want to continue (y/n)[n]?`
4. Enter **Y**(es) to accept.

Note: Use the auto configure option to test the read and write capabilities of every unit in the subsystem.

5. Enter **N**(o) to decline the auto configure option and to allow testing of a specific unit.
6. Enter **N**(o) to decline the default settings.

Note: To ensure that *DILX* accesses the entire unit space, enter 120 minutes or more in the next step. The default setting is 10 minutes.

7. Enter the number of minutes desired for running the test.
8. Enter the number of minutes between the display of performance summaries.
9. Enter **Y**(es) to include performance statistics in the summary.
10. Enter **Y**(es) to display both hard and soft errors.
11. Enter **Y**(es) to display the hex dump.

12. Press **Enter** or **Return** to accept the hard-error limit default.
13. Press **Enter** or **Return** to accept the soft-error limit default.
14. Press **Enter** or **Return** to accept the queue depth default.
15. Enter **1** to run the Basic Function test option.
16. Enter **Y**(es) to enable phase 1, the write test.
17. Enter **Y**(es) to accept the default percentage of requests that *DILX* issues as read requests during phase 2, the random I/O test.

    DILX issues the balance as write requests.
18. Enter **0** to select all data patterns that *DILX* issues for write requests.
19. Enter **Y**(es) to perform the initial write pass.
20. Enter **Y**(es) to allow *DILX* to compare the read and write data.
21. Press **Enter** or **Return** to accept the default percentage of reads and writes that *DILX* compares.
22. Enter the unit number of the specific unit to be tested (for example, to test D107, enter the number 107).
23. To test more than one unit, enter the appropriate unit numbers after prompted. Otherwise, enter **N**(o) to start the test.

Note: Use the command sequences shown in Table 33 on page 120 to control the test.

DILX error codes

Table 35 explains the error codes that *DILX* might display during and after testing.

Table 35: *DILX* Error Codes

Error Code	Message and Explanation
1	`Illegal Data Pattern Number found in data pattern header.` Explanation: *DILX* read data from the unit and discovered that the data did not conform to the pattern that *DILX* had previously written.

Table 35: *DILX* Error Codes (Continued)

Error Code	Message and Explanation
2	`No write buffers correspond to data pattern.` Explanation: *DILX* read a legal data pattern from the unit, but because no write buffers correspond to the pattern, the data must be considered corrupt.
3	`Read data does not match write buffer.` Explanation: *DILX* compared the read and write data and discovered that they did not correspond.
4	`Compare host data should have reported a compare error but did not.` Explanation: A compare host data compare was issued in a way that *DILX* expected to receive a compare error, but no error was received.

Format and device code load utility (HSUTIL)

Use the *HSUTIL* utility to upgrade the firmware on disk drives in the subsystem and to format disk drives. While formatting disk drives or installing new firmware, *HSUTIL* might produce one or more of the messages shown in Table 36 (many of the self-explanatory messages have been omitted from the table).

Note: Disk format times are approximate. If a device takes greater than 20 percent more time than the estimate, you may need to monitor the device to see if it performs well. The device format time is approximate; however, if the device encounters many block revector operations during formatting, it can take longer for the formatting to complete.

Table 36: HSUTIL Messages and Inquiries

Message	Description
`Insufficient resources.`	*HSUTIL* cannot find or perform the operation because internal controller resources are not available.
`Unable to change operation mode to maintenance for unit.`	*HSUTIL* was unable to put the source single-disk drive unit into Maintenance mode to enable formatting or code load.
`Unit successfully allocated.`	*HSUTIL* has allocated the single-disk drive unit for code load operation. At this point, the unit and the associated device are not available for other subsystem operations.
`Unable to allocate unit.`	*HSUTIL* could not allocate the single-disk drive unit. An accompanying message explains the reason.
`Unit is owned by another sysop.`	Device cannot be allocated because the device is being used by another subsystem function or local program.
`Unit is in maintenance mode.`	Device cannot be formatted or code loaded because the device is being used by another subsystem function or local program.
`Exclusive access is declared for unit.`	Another subsystem function has reserved the unit shown.
`The other controller has exclusive access declared for unit.`	The companion controller has locked out “this controller” from accessing the unit shown.
`The RUNSTOP_SWITCH is set to RUN_DISABLED for unit.`	The *RUN* and *NORUN* unit indicator for the unit shown is set to *NORUN*; the disk cannot spin up.

Table 36: HSUTIL Messages and Inquiries (Continued)

Message	Description
`What BUFFER SIZE (in BYTES) does the drive require (2048, 4096, 8192) [8192]?`	*HSUTIL* detects that an unsupported device is selected as the target device and the firmware image requires multiple SCSI Write Buffer commands. Specify the number of bytes to be sent in each Write Buffer command. The default buffer size is 8192 bytes. A firmware image of 256 K, for example, can be code loaded in 32 Write Buffer commands, each transferring 8192 bytes.
`What is the TOTAL SIZE of the code image in BYTES [`*`device default`*`]?`	*HSUTIL* detects that an unsupported device is selected as the target device. Enter the total number of bytes of data to be sent in the code load operation.
`Does the target device support only the download microcode and save?`	*HSUTIL* detects that an unsupported device is selected as the target device. Specify whether the device supports the SCSI Write Buffer command download and save function.
`Should the code be downloaded with a single write buffer command?`	*HSUTIL* detects that an unsupported device is selected as the target device. Indicate whether to download the firmware image to the device in one or more contiguous blocks, each corresponding to one SCSI Write Buffer command.

Configuration (CONFIG) utility

Use the *CONFIG* utility to add one or more storage devices to the subsystem. This utility checks the device ports for new disk drives, adds them to the controller configuration, and automatically names them. Refer to the controller installation and configuration guide for more information about the *CONFIG* utility.

Code Load and Code Patch (CLCP) utility

Use the *CLCP* utility to upgrade the controller software and the EMU software. Also use *CLCP* to patch the controller software. To successfully install a new controller, the correct (or current) software version and patch numbers must be available. See Figure 24 for an example of the *CLCP* screen display that lists software patches, or refer to the controller maintenance and service guide for more information about this utility during a replacement or upgrade process.

```
The following patches are currently stored in the patch area:
  Software    Patch
   Version    Number   Checksum
   --------   ------   --------
     V86P       2      79517D9B
     V86P       3      CB34D779
     V86P       4      32D6D171
     V86P       5      41884790
     V86P       6      5587F375
     V86P       7      D600BC72
     V86P       8      096F5BCE
     V86P       9      13A2DC24
     V86P       10     75D52E8B
     V87        2      7E1263F1
     V87        3      F5FD5EBF
     V87        4      E897C93E
     V87        5      E9D39F31
     V87        6      BE789D1A
     V87        7      9A16FCEB
     V87        8      0660CA57
Currently, 12% of the patch area is free.
```

Figure 24: Example of a listing of patches with associated checksum values

Note: Only HP authorized service providers can upload EMU microcode updates. Contact HP technical support for directions to obtain the appropriate EMU microcode and installation guide.

CLONE utility

Use the *CLONE* utility to duplicate the data on any unpartitioned single-disk unit, stripeset, mirrorset, or striped mirrorset. Back up the cloned data while the actual storageset remains online. After the cloning operation is done, back up the clones rather than the storageset or single-disk unit, which can continue to service the I/O load. After cloning a mirrorset, the *CLONE* utility does not need to create a temporary mirrorset. Instead, the *CLONE* utility adds a temporary member to the mirrorset and copies the data onto this new member.

The *CLONE* utility creates a temporary, two-member mirrorset for each member in a single-disk unit or stripeset. Each temporary mirrorset contains one disk drive from the unit being cloned and one disk drive onto which the *CLONE* utility copies the data. During the copy operation, the unit remains online and active so the clones contain the most up-to-date data.

After the *CLONE* utility copies the data from the members to the clones, the *CLONE* utility restores the unit to the original configuration and creates a clone unit for backup purposes.

Field Replacement Utility (FRUTIL)

Use *FRUTIL* to replace a failed controller, cache module, or ECB, in a dual-redundant controller configuration, without shutting down the subsystem. Refer to the controller maintenance and service guide for a more detailed explanation of how *FRUTIL* is used during the replacement process.

Note: *FRUTIL* cannot run in remote copy set environments while I/O is in progress to the target side due to host write and normalization (ACS V8.8P only).

Change Volume Serial Number (CHVSN) utility

Use the *CHVSN* utility to generate a new volume serial number (called VSN) for the specified device and to write the VSN on the media. The *CHVSN* utility is used to eliminate duplicate volume serial numbers and to rename duplicates with different volume serial numbers.

Note: Only HP authorized service providers can use this utility.

Event Reporting Templates

3

This chapter describes the event codes the fault management software provides for spontaneous events and last failure events.

Topics include:

- Passthrough Device Reset Event Sense Data Response template, page 137
- Last Failure Event Sense Data Response template (Template 01), page 138
- Multiple-Bus Failover Event Sense Data Response template (Template 04), page 140
- Failover Event Sense Data Response template (Template 05), page 142
- Device Discovery Error Sense Data Response template (Template 06), page 144
- Nonvolatile Parameter Memory Component Event Sense Data Response template (Template 11), page 145
- Backup Battery Failure Event Sense Data Response template (Template 12), page 147
- Subsystem Built-In Self-Test Failure Event Sense Data Response template (Template 13), page 149
- Memory System Failure Event Sense Data Response template (Template 14), page 151
- Device Services Nontransfer Error Event Sense Data Response template (Template 41), page 153
- Disk Transfer Error Event Sense Data Response template (Template 51), page 155
- Data Replication Manager Services Event Sense Response template (Template 90), page 157
- Connection Table Full Event Error template (Template A0), page 159

The array controller uses the following codes to report different types of events. These codes are presented in template displays:

- Instance Codes identify events and Additional Sense Codes (ASC)
- Additional Sense Code Qualifiers (ASCQ) explain the cause of the events
- LFCs describe unrecoverable conditions that might occur with the controller

---

Note: Error log messages in this chapter are used for all HP StorageWorks controller devices; therefore, some of the events reported in this chapter might not be applicable to the HSG60 and HSG80 controller.

Passthrough Device Reset Event Sense Data Response template

Events reported by passthrough devices during host and device operations are conveyed directly to the host system without intervention or interpretation by the array controllers, with the exception of device sense data that is truncated to 160 bytes if it exceeds 160 bytes.

Events that are related to passthrough device recognition, initialization, and SCSI bus communication events, result in a reset of a passthrough device by the HSG60 and HSG80 controller. These events are reported through standard SCSI Sense Data (see Table 37). For all other events, see the templates contained within this section.

- ASC and ASCQ codes (byte offsets 12 and 13) are detailed in the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161.
- Instance Codes (byte offsets 8–11) are detailed in the "Instance Codes" chapter that starts on page 177.

Table 37: Passthrough Device Reset Event Sense Data Response Format

↓ offset	bit →	7	6	5	4	3	2	1	0
0		Valid	Error code						
1		Segment							
2		FM	EOM	ILI	Reserved	Sense key			
3–6		Information							
7		Additional sense length							
8–11		Instance Code							
12		ASC							
13		ASCQ							
14		Field-replaceable unit code							
15		SKSV	Sense key specific						
16		Sense key specific							
17		Sense key specific							

Last Failure Event Sense Data Response template (Template 01)

Unrecoverable conditions detected by either software or hardware, and certain operator-initiated conditions, terminate controller operation. In most cases, following such a termination, the controller attempts to restart with hardware components and software data structures initialized to the states necessary to perform normal operations (see Table 38). Following a successful restart, the condition that caused controller operation to terminate is signaled to all host systems on all logical units.

Note: For ACS V8.8P configurations, Last Failure events generated by the target are not signaled to any host unless the host has a direct connection to the target—which is not through the initiator. In addition, these events might not appear on the initiator.

- ASC and ASCQ codes (byte offsets 12 and 13) are detailed in the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161.
- Instance Codes (byte offsets 32–35) are detailed in the "Instance Codes" chapter that starts on page 177.
- LFCs (byte offsets 104–107) are detailed in the "Last Failure Codes" chapter that starts on page 211.

Table 38: Template 01—Last Failure Event Sense Data Response Format

↓ offset	bit →	7	6	5	4	3	2	1	0
0	Unused		Error code						
1	Unused								
2	Unused					Sense key			
3–6	Unused								
7	Additional sense length								
8–11	Unused								
12	ASC								
13	ASCQ								
14	Unused								
15–17	Unused								
18–31	Reserved								
32–35	Instance Code								

Table 38: Template 01—Last Failure Event Sense Data Response Format (Continued)

↓ offset	bit →	7	6	5	4	3	2	1	0
36	Template								
37	Template flags								
38–53	Reserved								
54–69	Controller board serial number								
70–73	Controller software revision level								
74	Reserved or patch version (TM2)								
75	Reserved								
76	LUN status								
77–103	Reserved								
104–107	LFC								
108–111	Last failure parameter [0]								
112–115	Last failure parameter [1]								
116–119	Last failure parameter [2]								
120–123	Last failure parameter [3]								
124–127	Last failure parameter [4]								
128–131	Last failure parameter [5]								
132–135	Last failure parameter [6]								
136–139	Last failure parameter [7]								
140–159	Reserved								

Multiple-Bus Failover Event Sense Data Response template (Template 04)

The controller SCSI host interconnect services software component reports Multiple-bus failover events through the Multiple-Bus Failover Event Sense Data Response (see Table 39). The error or condition is signaled to all host systems on all logical units.

- ASC and ASCQ codes (byte offsets 12 and 13) are detailed in the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161.
- Instance Codes (byte offsets 32–35) are detailed in the "Instance Codes" chapter that starts on page 177.

Table 39: Template 04—Multiple-Bus Failover Event Sense Data Response Format (Sheet 1 of 2)

↓ offset	bit →	7	6	5	4	3	2	1	0
0		Unused	Error code						
1	Unused								
2	Unused					Sense key			
3–6	Unused								
7	Additional sense length								
8–11	Unused								
12	ASC								
13	ASCQ								
14	Unused								
15–17	Unused								
18–26	Reserved								
27	Failed controller target number								
28–31	Affected LUNs								
32–35	Instance Code								
36	Template								
37	Template flags								
38–53	Other controller board serial number								
54–69	Controller board serial number								
70–73	Controller software revision level								
74	Reserved or patch version (TM2)								

Table 39: Template 04—Multiple-Bus Failover Event Sense Data Response Format (Sheet 2 of 2)

↓ offset	bit →	7	6	5	4	3	2	1	0
75	Reserved								
76	LUN status								
77–103	Reserved								
104–131	Affected LUNs Extension (TM0)								
132–159	Reserved								

Failover Event Sense Data Response template (Template 05)

The controller failover control software component reports errors, and other conditions encountered during redundant controller communications and failover operation through the Failover Event Sense Data Response (see Table 40). The error or condition is signaled to all host systems on all logical units.

- ASC and ASCQ codes (byte offsets 12 and 13) are detailed in the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161.
- Instance Codes (byte offsets 32–35) are detailed in the "Instance Codes" chapter that starts on page 177.
- LFCs (byte offsets 104–107) are detailed in the "Last Failure Codes" chapter that starts on page 211.

Table 40: Template 05—Failover Event Sense Data Response Format

↓ offset	bit →	7	6	5	4	3	2	1	0
0		Unused	Error code						
1	Unused								
2	Unused					Sense key			
3–6	Unused								
7	Additional sense length								
8–11	Unused								
12	ASC								
13	ASCQ								
14	Unused								
15–17	Unused								
18–31	Reserved								
32–35	Instance Code								
36	Template								
37	Template flags								
38–53	Reserved								
54–69	Controller board serial number								
70–73	Controller software revision level								
74	Reserved or patch version (TM2)								
75	Reserved								
76	LUN status								

Table 40: Template 05—Failover Event Sense Data Response Format (Continued)

↓ offset	bit →	7	6	5	4	3	2	1	0
77–103	Reserved								
104–107	LFC								
108–111	Last failure parameter [0]								
112–115	Last failure parameter [1]								
116–119	Last failure parameter [2]								
120–123	Last failure parameter [3]								
124–127	Last failure parameter [4]								
128–131	Last failure parameter [5]								
132–135	Last failure parameter [6]								
136–139	Last failure parameter [7]								
140–159	Reserved								

Device Discovery Error Sense Data Response template (Template 06)

This template format is used internally to construct *FMU* output data for CLI output and cannot be exported through reporting mechanisms external to the host.

Nonvolatile Parameter Memory Component Event Sense Data Response template (Template 11)

The controller executive software component reports errors detected while accessing a nonvolatile parameter memory component through the Nonvolatile Parameter Memory Component Event Sense Data Response (see Table 41). Errors are signaled to all host systems on all logical units.

- ASC and ASCQ codes (byte offsets 12 and 13) are detailed in the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161.
- Instance Codes (byte offsets 32–35) are detailed in the "Instance Codes" chapter that starts on page 177.

Table 41: Template 11—Nonvolatile Parameter Memory Component Event Sense Data Response Format

↓ offset	bit → 7	6	5	4	3	2	1	0
0	Unused	Error code						
1	Unused							
2	Unused				Sense key			
3–6	Unused							
7	Additional sense length							
8–11	Unused							
12	ASC							
13	ASCQ							
14	Unused							
15–17	Unused							
18–31	Reserved							
32–35	Instance Code							
36	Template							
37	Template flags							
38–53	Reserved							
54–69	Controller board serial number							
70–73	Controller software revision level							
74	Reserved or patch version (TM2)							
75	Reserved							
76	LUN status							

Table 41: Template 11—Nonvolatile Parameter Memory Component Event Sense Data Response Format (Continued)

↓ offset	bit →	7	6	5	4	3	2	1	0
77–103	Reserved								
104–107	Memory address								
108–111	Byte count								
112–114	Number of times written								
115	Undefined								
116–159	Reserved								

Backup Battery Failure Event Sense Data Response template (Template 12)

The controller value-added services software component reports backup battery failure conditions for the various hardware components that use a battery to maintain state during power failures through the Backup Battery Failure Event Sense Data Response (see Table 42). The failure condition is signaled to all host systems on all logical units.

- ASC and ASCQ codes (byte offsets 12 and 13) are detailed in the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161.
- Instance Codes (byte offsets 32–35) are detailed in the "Instance Codes" chapter that starts on page 177.

Table 42: Template 12—Backup Battery Failure Event Sense Data Response Format

↓ offset	bit →	7	6	5	4	3	2	1	0
0	Unused		Error code						
1	Unused								
2	Unused				Sense key				
3–6	Unused								
7	Additional sense length								
8–11	Unused								
12	ASC								
13	ASCQ								
14	Unused								
15–17	Unused								
18–31	Reserved								
32–35	Instance Code								
36	Template								
37	Template flags								
38–53	Reserved								
54–69	Controller board serial number								
70–73	Controller software revision level								
74	Reserved or patch version (TM2)								
75	Reserved								
76	LUN status								

Table 42: Template 12—Backup Battery Failure Event Sense Data Response Format

↓ offset	bit →	7	6	5	4	3	2	1	0
77–103	Reserved								
104–107	Memory address								
108–159	Reserved								

Subsystem Built-In Self-Test Failure Event Sense Data Response template (Template 13)

The controller subsystem built-in self-test software component reports errors detected during test execution through the Subsystem Built-In Self-Test Failure Event Sense Data Response (see Table 43). Errors are signaled to all host systems on all logical units.

- ASC and ASCQ codes (byte offsets 12 and 13) are detailed in the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161.
- Instance Codes (byte offsets 32–35) are detailed in the "Instance Codes" chapter that starts on page 177.

Table 43: Template 13—Subsystem Built-In Self Test Failure Event Sense Data Response Format

↓ offset	bit →	7	6	5	4	3	2	1	0
0		Unused	Error code						
1	Unused								
2	Unused				Sense key				
3–6	Unused								
7	Additional sense length								
8–11	Unused								
12	ASC								
13	ASCQ								
14	Unused								
15–17	Unused								
18–31	Reserved								
32–35	Instance Code								
36	Template								
37	Template flags								
38–53	Reserved								
54–69	Controller board serial number								
70–73	Controller software revision level								
74	Reserved or patch version (TM2)								
75	Reserved								
76	LUN status								

Table 43: Template 13—Subsystem Built-In Self Test Failure Event Sense Data Response Format (Continued)

↓ offset	bit →	7	6	5	4	3	2	1	0
77–103	Reserved								
104–105	Undefined								
106	Header type								
107	Header flags								
108	TE								
109	Test number								
110	Test command								
111	Test flags								
112–113	Error code								
114–115	Return Code								
116–119	Address of error								
120–123	Expected error data								
124–127	Actual error data								
128–131	Extra status 1								
132–135	Extra status 2								
136–139	Extra status 3								
140–159	Reserved								

Memory System Failure Event Sense Data Response template (Template 14)

The controller memory controller event analyzer software component and the Cache Manager, part of the Value-added (VA) software component, report the occurrence of memory errors through the Memory System Failure Event Sense Data Response (see Table 44). Errors are signaled to all host systems on all logical units.

- ASC and ASCQ codes (byte offsets 12 and 13) are detailed in the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161.
- Instance Codes (byte offsets 32–35) are detailed in the "Instance Codes" chapter that starts on page 177.

Table 44: Template 14—Memory System Failure Event Sense Data Response format

↓ offset	bit →	7	6	5	4	3	2	1	0
0		Unused	Error code						
1		Unused							
2		Unused				Sense key			
3–6		Unused							
7		Additional sense length							
8–11		Unused							
12		ASC							
13		ASCQ							
14		Unused							
15–17		Unused							
18–19		Reserved							
20–23		Reserved or RDR2 (TM1)							
24–27		Reserved or RDEAR (TM1)							
28–31		Reserved							
32–35		Instance Code							
36		Template							
37		Template flags							
38–39		Reserved							
40–43		Reserved or FXPSCR (TM1)							

Table 44: Template 14—Memory System Failure Event Sense Data Response format (Continued)

↓ offset	bit →	7	6	5	4	3	2	1	0
44–47	Reserved or FXCSR (TM1)								
48–51	Reserved or FXCCSR (TM1)								
52–53	Reserved								
54–69	Controller board serial number								
70–73	Controller software revision level								
74	Reserved or patch version (TM2)								
75	Reserved								
76	LUN status								
77–79	Reserved								
80–83	Reserved or FXPAEC (TM1)								
84–87	Reserved or FXCAEC (TM1)								
88–91	Reserved or FXPAEP (TM1)								
92–95	Reserved or CHC (TM0) or FXCAEP (TM1)								
96–99	Reserved or CMC (TM0) or CFW (TM1)								
100–103	Reserved or DSR2 (TM0) or RRR (TM1)								
104–107	Memory address								
108–111	Byte count								
112–115	DSR or PSR (TM1)								
116–119	CSR or CSR (TM1)								
120–123	DCSR or EAR (TM1)								
124–127	DER or EDR1 (TM1)								
128–131	EAR or EDR0 (TM1)								
132–135	EDR or ICR (TM1)								
136–139	ERR or IMR (TM1)								
140–143	RSR or DID (TM1)								
144–147	RDR0								
148–151	RDR1								
152–155	WDR0								
156–159	WDR1								

Device Services Nontransfer Error Event Sense Data Response template (Template 41)

The controller device services software component reports errors detected while performing nontransfer work-related functions to disk (including CD-ROM and optical memory) device operations through the Device Services Nontransfer Event Sense Data Response (see Table 45). If an error occurred during the execution of a command issued by an HSG60 and HSG80 controller software component, it is signaled to all host systems on all logical units.

- ASC and ASCQ codes (byte offsets 12 and 13) are detailed in the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161.
- Instance Codes (byte offsets 32–35) are detailed in the "Instance Codes" chapter that starts on page 177.

Table 45: Template 41—Device Services Non-Transfer Error Event Sense Data Response Format

↓ offset	bit →	7	6	5	4	3	2	1	0
0		Unused	Error code						
1	Unused								
2	Unused				Sense key				
3–6	Unused								
7	Additional sense length								
8–11	Unused								
12	ASC								
13	ASCQ								
14	Unused								
15–17	Unused								
18–31	Reserved								
32–35	Instance Code								
36	Template								
37	Template flags								
38–53	Reserved								
54–69	Controller board serial number								
70–73	Controller software revision level								
74	Reserved or patch version (TM2)								

Table 45: Template 41—Device Services Non-Transfer Error Event Sense Data Response Format (Continued)

↓ offset	bit →	7	6	5	4	3	2	1	0
75	Reserved								
76	LUN status								
77–103	Reserved								
104	Associated port								
105	Associated target								
106	Associated ASC								
107	Associated ASC qualifier								
108–159	Reserved								

Disk Transfer Error Event Sense Data Response template (Template 51)

The controller device services and value-added services software components report errors detected while performing work related to disk (including CD-ROM and optical memory) device transfer operations through the Disk Transfer Error Event Sense Data Response (see Table 46). If an error occurred during the execution of a command issued by an array controller software component, the error is signaled to all host systems on the logical unit associated with the physical unit that reported the error.

- ASC and ASCQ codes (byte offsets 12 and 13) are detailed in the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161.
- Instance Codes (byte offsets 32–35) are detailed in the "Instance Codes" chapter that starts on page 177.

Table 46: Template 51—Disk Transfer Error Event Sense Data Response Format

↓ offset	bit →	7	6	5	4	3	2	1	0
0–17	Standard sense data								
18–19	Reserved								
20	Total number of errors								
21	Total retry count								
22–25	ASC and ASCQ stack								
26–28	Device locator								
29–31	Reserved								
32–35	Instance Code								
36	Template								
37	Template flags								
38	Reserved								
39	Command OpCode								
40	Sense data qualifier								
41–50	Original CDB								
51	Host ID								
52–53	Reserved								
54–69	Controller board serial number								
70–73	Controller software revision level								

Table 46: Template 51—Disk Transfer Error Event Sense Data Response Format (Continued)

↓ offset	bit →	7	6	5	4	3	2	1	0
74	Reserved or patch version (TM2)								
75	Reserved								
76	LUN status								
77–78	Reserved								
79–82	Device firmware revision level								
83–98	Device product ID								
99–100	Reserved								
101	Device type								
102–103	Reserved								
104–121	Device sense data								
122–159	Reserved								

Data Replication Manager Services Event Sense Response template (Template 90)

This section applies only to ACS V8.8P. The controller Data Replication Manager services software component reports events through the Data Replication Manager Services Event Sense Data Response.

With Data Replication Manager, fault management events are reported on Template 90, shown in Table 47. The error is signaled to all host systems on the logical unit associated with the initiator unit that reported the error.

- ASC and ASCQ codes (byte offsets 12 and 13) are detailed in the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161.
- Instance Codes (byte offsets 32–35) are detailed in the "Instance Codes" chapter that starts on page 177.

Table 47: Template 90—Data Replication Manager Services Event Sense Data Response Format for ACS V8.8-*x*P Only

↓ offset	bit →	7	6	5	4	3	2	1	0
0		Unused	Error code						
1		Unused							
2		Unused				Sense key			
3–6		Unused							
7		Additional sense length							
8–11		Unused							
12		ASC							
13		ASCQ							
14		Unused							
15–17		Unused							
18–27		Reserved							
28–31		Reserved or log unit number (TMO)							
32–35		Instance Code							
36		Template							
37		Template flags							
38–53		Target controller board serial number							
54–69		Controller board serial number							
70–73		Controller software revision level							

Table 47: Template 90—Data Replication Manager Services Event Sense Data Response Format for ACS V8.8-*x*P Only (Continued)

↓ offset	bit →	7	6	5	4	3	2	1	0
74	Reserved or patch version (TM2)								
75	Reserved								
76	LUN status								
77–79	Reserved								
80–95	Initiator WWLID								
96–103	Initiator node name								
104–107	Initiator unit number								
108–123	Target WWLID								
124–131	Target node name								
132–135	Target unit number								
136–139	Number of targets								
140–148	Remote copy set name								
149–157	Reserved or association set name (TM0)								
158–159	Reserved								

Connection Table Full Event Error template (Template A0)

This template format is used internally to construct *FMU* output data for CLI output and cannot be exported through reporting mechanisms external to the host.

ASC, ASCQ, Repair Action, and Component Identifier Codes

4

This chapter describes ASC and ASCQ codes, recommended Repair Action Codes, and Component Identifier (ID) Codes found in the various templates.

Topics include:

- Vendor-specific SCSI ASC and ASCQ codes, page 162
- Recommended Repair Action Codes, page 167
- Component ID Codes, page 175

Vendor-specific SCSI ASC and ASCQ codes

Table 48 lists HSG60 and HSG80 controller vendor-specific SCSI ASC and ASCQ codes. These codes are also template-specific and appear at byte offsets 12 and 13.

Note: Additional codes that are common to all SCSI devices can be found in the *Small Computer System Interface-2 (SCSI-2)* specification.

Table 48: ASC and ASCQ Code Descriptions (Sheet 1 of 5)

ASC Code	ASCQ Code	Description
04	80	Logical unit is disaster tolerant failsafe locked (inoperative).
3F	85	Test unit ready or read capacity command failed (see the "Device Discovery Error report" section that starts on page 53).
3F	87	Drive failed by a host mode select command.
3F	88	Drive failed due to a deferred error reported by drive.
3F	90	Unrecovered read or write error.
3F	C0	No response from one or more drives.
3F	C2	NV memory and drive metadata indicate conflicting drive configurations.
3F	CE	UPS two-minute warning (TMW) before `AC_FAIL`.
3F	D2	Synchronous transfer value differences between drives.
80	00	Forced error on read.
82	01	No command control structures available.
84	04	Command failed—SCSI ID verification failed.
85	05	Data returned from drive is invalid.
89	00	Request sense command to drive failed.
8A	00	Illegal command for Passthrough mode.
8C	04	Data transfer request error.
8F	00	Premature completion of a drive command.

Table 48: ASC and ASCQ Code Descriptions (Sheet 2 of 5)

ASC Code	ASCQ Code	Description
91	00	Mode select errors.
91	01	LUN exist; cannot add LUN.
91	02	LUN does not exist; cannot replace LUN.
91	03	Drive already exists; cannot add drive.
91	04	Drive does not exist; cannot do requested drive function.
91	05	Cannot delete drive; it is part of a LUN.
91	06	Cannot fail drive; format in progress.
91	07	Cannot replace drive; drive not marked failed or replaced.
91	08	Specified action is invalid.
91	09	Invalid action with multiple sub-LUNs defined.
91	0A	Invalid reconstruction amount.
91	0B	Invalid reconstruction frequency.
91	0C	Invalid LUN block size.
91	0D	Invalid LUN type.
91	0E	Invalid segment size.
91	0F	Invalid segment zero size.
91	10	Invalid number of drives in LUN.
91	11	Invalid number LUN blocks.
91	12	Invalid RAID level.
91	13	Invalid drive sector size.
91	14	Invalid LUN block size or drive sector size Modulo.
91	15	No disks defined for LUN.
91	16	Insufficient rank structures available to define LUN.
91	17	Disk defined multiple times for LUN.
91	18	Sub-LUN drives differ from those used by other sub-LUNs.
91	19	Sub-LUN RAID level mismatch.

Table 48: ASC and ASCQ Code Descriptions (Sheet 3 of 5)

ASC Code	ASCQ Code	Description
91	1A	First defined sub-LUN not formatted, second sub-LUN is illegal.
91	1B	Non sub-LUN drive already owned by another LUN.
91	1C	Sub-LUN drive already owned by a non sub-LUN.
91	1D	Drive type differs from others in LUN.
91	1E	Drive cannot be added to rank because rank is full.
91	1F	Ranks have different number of disks defined.
91	20	Multiple drives on same channel within same rank.
91	21	Mirrored disks on same channel.
91	22	No parity disk defined.
91	23	No data disks defined.
91	24	Too many disks defined.
91	25	No space available to define LUN. Sub-LUN cannot be defined.
92	00	Controller cannot clear busy status from drive.
93	00	Drive returned vendor-unique sense data.
94	00	Invalid request of a redundant controller.
A0	00	Last Failure Event report.
A0	01	Nonvolatile Parameter Memory Component Event report.
A0	02	Backup Battery Failure Event report.
A0	03	Subsystem Built-In Self-Test Failure Event report.
A0	04	Memory System Failure Event report.
A0	05	Failover Event report.
A0	07	RAID Membership Event report.
A0	08	Multiple-bus failover event.
A0	09	Multiple-bus failback event.
A0	0A	Disaster tolerance failsafe error mode can now be enabled.
A0	0B	Connection table is full.

Table 48: ASC and ASCQ Code Descriptions (Sheet 4 of 5)

ASC Code	ASCQ Code	Description
A1	00	Shelf OK is not properly asserted.
A1	01	Unable to clear swap interrupt. Interrupt disabled.
A1	02	Swap interrupt re-enabled.
A1	03	Asynchronous swap detected.
A1	04	Controller shelf OK is not properly asserted.
A1	0A	EMU fault: power supplies not OK.
A1	0B	EMU fault: fans not OK.
A1	0C	EMU fault: temperature not OK.
A1	0D	EMU fault: external air sense not OK.
A1	10	Power supply fault is now fixed.
A1	11	Fans fault is now fixed.
A1	12	Temperature fault is now fixed.
A1	13	External air sense fault is now fixed.
A1	14	EMU and cabinet now available.
A1	15	EMU and cabinet now unavailable.
A2	00	Peer-to-peer remote copy connection event.
A2	01	Remote copy set membership event.
B0	00	Command timeout.
B0	01	Watchdog timer timeout.
D0	01	Disconnect timeout.
D0	02	Chip command timeout.
D0	03	Byte transfer timeout.
D1	00	Bus errors.
D1	02	Unexpected bus phase.
D1	03	Disconnect expected.
D1	04	ID message not sent.
D1	05	Synchronous negotiation error.
D1	07	Unexpected disconnect.
D1	08	Unexpected message.

Table 48: ASC and ASCQ Code Descriptions (Sheet 5 of 5)

ASC Code	ASCQ Code	Description
D1	09	Unexpected tag message.
D1	0A	Channel busy.
D1	0B	Device initialization failure. Device sense data available.
D2	00	Miscellaneous SCSI driver error.
D2	03	Device services had to reset the bus.
D3	00	Drive SCSI chip reported gross error.
D4	00	Non-SCSI bus parity error.
D5	02	Message reject received on a valid message.
D7	00	Source driver programming error.
E0	03	Fault Manager detected an unknown error code.
E0	06	Maximum number of errors for this I/O exceeded.
E0	07	Drive reported recovered error without transferring all data.

Recommended Repair Action Codes

Recommended Repair Action Codes are embedded in Instance and Last Failure Codes. For a more detailed description of the relationship between these codes, see the "Instance Codes" chapter that starts on page 177 and the "Last Failure Codes" chapter that starts on page 211.

Table 49 contains the Repair Action Codes assigned to each significant event in the system.

Table 49: Recommended Repair Action Codes (Sheet 1 of 8)

Code	Description
00	No action necessary.
01	An unrecoverable hardware-detected fault occurred or an unrecoverable software inconsistency was detected. Proceed with controller support avenues. Contact an HP authorized service provider.
03	Follow the recommended Repair Action contained as indicated in the LFC.
04	Two possible problem sources are indicated: ■ In the case of a shelf with dual power supplies, one of the power supplies has failed. Follow Repair Action 07 for the power supply with the Power LED out. ■ One of the shelf fans has failed. Follow Repair Action 06.
05	Four possible problem sources are indicated: ■ Total power supply failure on a shelf. Follow Repair Action 09. ■ A device inserted into a shelf that has a broken internal SBB connector. Follow Repair Action 0A. ■ A standalone device is connected to the controller with an incorrect cable. Follow Repair Action 08. ■ A controller hardware failure. Follow Repair Action 20.
06	Determine which fan has failed and replace the fan.
07	Replace power supply.
08	Replace the cable. Refer to the specific device documentation.
09	Determine power failure cause.
0A	Determine which SBB has a failed connector and replace the SBB.

Table 49: Recommended Repair Action Codes (Sheet 2 of 8)

Code	Description
0B	The "other controller" in a dual-redundant configuration was reset with the kill line by the controller that reported the event. To restart the non-operational controller, enter the CLI command, `RESTART OTHER`, on the *surviving* controller, and then depress the (//) **Reset** button on the non-operational controller. If the "other controller" is repeatedly being made inoperative for the same or a similar reason, follow Repair Action 20.
0C	Both controllers in a dual-redundant configuration are attempting to use the same SCSI ID (either 6 or 7 as indicated in the event report). The "other controller" of the dual-redundant pair was reset with the kill line by the controller that reported the event. Two possible problem sources are indicated: ■ A controller hardware failure. ■ A controller backplane failure. First, follow Repair Action 20 for the inoperative controller. If the problem persists, follow Repair Action 20 for the *surviving* controller. If the problem still persists, replace the controller backplane.
0D	The EMU has detected an elevated temperature condition. Check the shelf and its components for the cause of the fault.
0E	The EMU has detected an external air-sense fault. Check components outside of the shelf for the cause of the fault.
0F	An environmental fault previously detected by the EMU is now fixed. This event report is notification that the repair was successful.
10	Restore on-disk configuration information to original state.
11	The UPS signaled a TMW before signaling an AC line failure. UPS signals are ignored until this condition clears. ■ Repair or replace the UPS. ■ The communication cable between the UPS and PVA is missing or damaged. Replace the cable.

Table 49: Recommended Repair Action Codes (Sheet 3 of 8)

Code	Description
20	Repair Action Code 20 failures are bus-related failures and the indicated modules reside on the PCI Data or Address Line (PDAL) bus. Follow these steps to determine what caused the failure: 1. Replace the controller with a known good controller. 2. Replace the cache module associated with “this controller” with a known good module. 3. Replace the cache module associated with “other controller” with a known good module. 4. Replace the ECBs for “this controller” with known good ECBs. 5. Pull all modules and examine connectors for bent pins. 6. Replace controller cabinet assembly. If the failure is not resolved after step 5, the problem is most likely backplane printed circuit faults.
22	Replace the indicated cache module or the appropriate memory DIMMs on the indicated cache module.
23	Replace the indicated write cache battery. **Caution:** Battery replacement can cause injury. Follow the directions that come with the new battery.
24	Check for the following invalid write cache configurations: ■ If the wrong write cache module is installed, replace with the matching module or clear the invalid cache error through the CLI. Refer to the controller CLI reference guide for more information. ■ If the write cache module is missing, reseat the cache module if the cache module is present, or add the missing cache module, or clear the invalid cache error through the CLI. Refer to controller CLI reference guide for more details. ■ If in a dual-redundant configuration and one of the write cache modules is missing, match write cache boards with both controllers.
25	An unrecoverable memory system failure occurred. After restart, the controller generates one or more Memory System Failure Event Sense Data Responses. Follow the Repair Actions contained therein.
37	The Memory System Failure translator could not determine the failure cause. Follow Repair Action 01.
38	Replace the indicated cache memory DIMM.

Table 49: Recommended Repair Action Codes (Sheet 4 of 8)

Code	Description
39	Check that the cache memory DIMMs are properly configured.
3A	This error applies to the mirrored cache for “this controller.” Since the mirrored cache is physically located on the “other controller” cache module, replace the “other controller” cache module or the appropriate memory DIMMs on the “other controller“ cache module.
3C	This error applies to “this controller” mirrored cache. Since the mirrored cache is physically located on the “other controller“ cache module, replace the indicated cache memory DIMM on the “other controller“ cache module.
3D	Either the primary cache or the mirrored cache has inconsistent data. Check for the following conditions to determine appropriate means to restore mirrored copies. 1. If the mirrored cache is reported as inconsistent and a previous *FRUTIL* warmswap of the mirrored cache module was unsuccessful, retry the procedure through the *FRUTIL*, by removing the module and re-inserting the same or a new module. 2. Otherwise, enter the CLI `SHUTDOWN THIS` command to clear the inconsistency upon restart.
3E	Replace the indicated cache module.
3F	No action necessary; cache diagnostics determines whether the indicated cache module is faulty.
40	If the Sense Data FRU field is non-zero, follow Repair Action 41. Otherwise, replace the appropriate FRU associated with the device SCSI interface or the entire device.
41	Consult the device maintenance manual for guidance on replacing the indicated device FRU.
43	Update the configuration data to correct the problem.
44	Replace the SCSI cable for the failing SCSI bus. If the problem persists, replace the controller backplane, drive backplane, or controller module.
45	Interpreting the device-supplied sense data is beyond the scope of the controller software. Refer to the device service manual to determine the appropriate repair action, if any.
50	The RAIDset is inoperative for one of the following reasons: ■ More than one member malfunctioned. Perform Repair Action 55. ■ More than one member is missing. Perform Repair Action 58. ■ Before reconstruction of a previously replaced member completes, another member becomes missing or malfunctions. Perform Repair Action 59. ■ The members have been moved around and the consistency checks show mismatched members. Perform Repair Action 58.

Table 49: Recommended Repair Action Codes (Sheet 5 of 8)

Code	Description
51	The mirrorset is inoperative for one of the following reasons: ■ The last Normal member has malfunctioned. Perform repair actions 55 and 59. ■ The last Normal member is missing. Perform Repair Action 58. ■ The members have been moved around and the consistency checks show mismatched members. Perform Repair Action 58.
52	The indicated storageset member was removed for one of the following reasons: ■ The member malfunctioned. Perform Repair Action 56. ■ By operator command. Perform Repair Action 57.
53	The storageset may be in a state that prevents adding a replacement member. Check the state of the storageset and its associated unit and resolve the problems found before adding the replacement member.
54	The device may be in a state that prevents adding the device as a replacement member or may not be large enough for the storageset. Use another device for the `ADD` action and perform Repair Action 57 for the device that failed to be added.
55	Perform the repair actions indicated in any and all event reports found for the devices that are members of the storageset.
56	Perform the repair actions indicated in any and all event reports found for the member device that was removed from the storageset. Then, perform Repair Action 57.
57	Delete the device from the failedset and redeploy, for example, by adding the device to the spareset so the device becomes available to replace another failing device.
58	Install the physical devices that are members of the storageset in the proper port, target, and LUN locations.
59	Delete the storageset, recreate the storageset with the appropriate `ADD`, `INITIALIZE`, and `ADD UNIT` CLI commands, and then reload the storageset contents from backup storage.
5A	Restore the mirrorset data from backup storage.
5B	The mirrorset is inoperative due to a disaster tolerance failsafe locked condition, as a result of the loss of all local or remote Normal and Normalizing members while *ERROR_MODE=FAILSAFE* was enabled. To clear the failsafe locked condition, enter the CLI command: `SET` *unit-number ERROR_MODE=NORMAL*

Table 49: Recommended Repair Action Codes (Sheet 6 of 8)

Code	Description
5C	The mirrorset has at least one local Normal or Normalizing member and one remote Normal or Normalizing member. Failsafe Error mode can now be enabled by entering the CLI command: `SET` *`unit-number ERROR_MODE=FAILSAFE`*
5D	The last member of the spareset was removed. Add new drives to the spareset.
5E	The single member mirrorset has an error in its metadata space which could not be corrected. Backup data from the mirror and initialize or replace the disk as soon as possible. Perform the following steps to remedy this issue: 1. Stop normal write activity to the single member mirrorset. 2. Backup data from the mirrorset with host backup software or equivalent. **Note:** Do *not* use the *CLONE* utility. 3. Delete the single member mirror unit, and delete the device. 4. Replace the disk drive with a good disk. 5. Create a single member mirror unit, and then initialize and restore data on the unit.
69	An unrecoverable fault occurred at the host port. There may be more than one entity attempting to use the same SCSI ID, or some other bus configuration error, such as improper termination, may exist. If no host bus configuration problems are found, follow Repair Action 01.
6A	The host connection table has reached its maximum host connections. To add new connections, you must remove *stale* entries (inactive connections still listed on the connection table) from the host connection table, or delete some of the existing host connections.
80	An EMU fault has occurred.
81	The EMU reported terminator power out of range. Replace the indicated I/O modules.

Table 49: Recommended Repair Action Codes (Sheet 7 of 8)

Code	Description
83	■ An EMU is unavailable. ■ This EMU (and associated cabinet) may have been removed from the subsystem; no action is required. ■ The cabinet has lost power. Restore power to the cabinet. ■ The EMU-to-EMU communications bus cable is disconnected or broken. Replace or reconnect the cable to reestablish communications. ■ The specified EMU is broken. Replace the EMU module. ■ The EMU in cabinet 0 is broken. Replace the EMU module.
88	The remote copy set has an online initiator unit and at least one remote Normal or Normalizing target member. Failsafe error mode can now be enabled by entering the following CLI command: `SET` *`remote-copy-set-name ERROR_MODE=FAILSAFE`*
89	The remote copy set is inoperative due to a disaster tolerance failsafe locked condition resulting from the loss of the local initiator unit or remote Normal or Normalizing target members while *`ERROR_MODE=FAILSAFE`* was enabled. To clear the failsafe locked condition, enter the following CLI command: `SET` *`remote-copy-set-name ERROR_MODE=NORMAL`*
8A	The indicated remote copy set target member was removed for one of the following reasons: ■ By operator command. ■ The member malfunctioned. Perform the repair actions indicated in any and all event reports found for that target member.
8B	Unable to communicate to the target member of the remote copy set for one of the following reasons: ■ The target malfunctioned. Perform the repair actions indicated in any and all event reports found for that target unit. ■ The target controller malfunctioned. Perform the repair actions indicated in any and all event reports found for that target controller. ■ Malfunction occurred in the Fibre Channel fabric between the peer controllers.
8C	Unable to communicate to an initiator unit of the remote copy set because the unit malfunctioned. Perform the repair actions indicated in any and all event reports found for that initiator unit.

Table 49: Recommended Repair Action Codes (Sheet 8 of 8)

Code	Description
8D	Not safe to present the Worldwide LUN ID (WWLID) to the host because a site failover may have taken place, but cannot confirm with the remote controller. Perform one of the following repair actions: ■ Follow Repair Action 8B. ■ If a site failover took place and you do not plan to perform a future site failback, delete the remote copy set on "this controller."
8E	Not safe to present the WWLID to the host because a site failover has taken place. Perform one of the following repair actions: ■ Perform a site failback. ■ Delete the remote copy set on "this controller."
8F	Unable to communicate to a log unit because the unit malfunctioned. Perform the repair actions indicated in any and all event reports found for that log unit.

90	An internal software structure for a write history log unit is inconsistent on "this controller" (the controller that failed).
	For this condition, the prior firmware (V8.7 and earlier) would have recursively failed with a trace similar to the following:
	`Controller LFC = 01942088 crash. PDAL recursive crash near`
	`PC = C016F144`
	`PARAM(7) = 0x00000A1C.`
	The controller would have then halted with LED (HEX) 25 in the LED codes.
	With V8.8 "this controller" (the controller that failed) comes up misconfigured so that it can avoid a recursive bug check failure.
	Follow these steps:
	1. On "the other" controller, issue the `SET NOFAILOVER` CLI command.
	2. Issue a `SET MULTICOPY=THIS` from "the other" controller that did not fail.
	Note: Note that there is a unit that is inoperative.
	3. Take corrective steps to resolve that unit.

Component ID Codes

Component ID Codes are embedded in Instance and Last Failure Codes. For a more detailed description of the relationship between these codes, see the "Instance Codes" chapter that starts on page 177 and the "Last Failure Codes" chapter that starts on page 211.

Table 50 lists the Component ID Codes.

Table 50: Component ID Codes

Code	Description
01	Executive services
02	Value-added (VA) services
03	Device services
04	Fault manager
05	Common library routines
06	Dual universal asynchronous receiver and transmitter services
07	Failover control
08	Nonvolatile parameter memory failover control
09	Facility lock manager
0A	Integrated logging facility
0B	Configuration manager process
0C	Memory controller event analyzer
0D	Power-off process
OE	Peer-to-peer remote copy services
12	VA services (extended)
20	Command Line Interface (CLI)
43	Host port protocol layer
44	Host port transport layer
64	SCSI host value-added services
80	*Disk Inline Exercise (DILX)*
82	*Subsystem Built-In Self-Tests (BIST)*
83	*Device Configuration (CONFIG)* Utilities
84	*Clone Unit Utility (CLONE)*

Table 50: Component ID Codes (Continued)

Code	Description
85	*Format and Device Code Load Utility (HSUTIL)*
86	*Code Load/Code Patch Utility (CLCP)*
8A	*Field Replacement Utility (FRUTIL)*
8B	*Periodic Diagnostics (PDIAG)*

Instance Codes

5

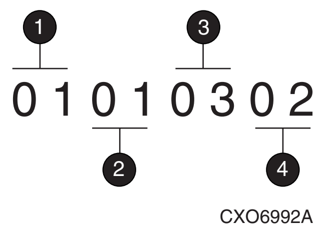
This chapter explains Instance Codes. An Instance Code is a number that uniquely identifies an event being reported.

Topics include:

- Instance Code structure, page 178
- Instance Code format, page 179

Instance Code structure

Figure 25 shows the structure of an Instance Code. By fully understanding this structure, each code can be translated without using *FMU*.



❶ Component ID number
❷ Event number
❸ Repair Action
❹ Notification and Recovery (NR) threshold

Figure 25: Structure of an Instance Code

Instance Code format

The format of an Instance Code as displayed in Sense Data Responses is shown in Table 51.

Table 51: Instance Code Format

offset	bit →	7	6	5	4	3	2	1	0
{8}32		NR threshold							
{9}33		Repair action							
{10}34		Event number							
{11}35		Component ID							

Note: The offset values enclosed in braces ({ }) apply only to the Passthrough Device Reset Event Sense Data Response format (see Table 37 on page 137). The nonbraced offset values apply only to the logical device event sense data response formats shown in the templates provided in the "Event Reporting Templates" chapter that starts on page 135.

Notification and recovery threshold

Located at byte offset {8}32 is the Notification and Recovery (NR) threshold assigned to the event. This two-digit value is used during symptom-directed diagnosis procedures to determine when to take NR action. For a description of event NR threshold classifications, see Table 52.

Table 52: Event Notification and Recovery (NR) Threshold Classifications

Threshold Value	Classification	Description
01	Immediate	Indicates either a failure or potential failure of a component critical to proper controller operation; immediate attention is required.
02	Hard	Indicates either a failure of a component that affects controller performance or inability to access a device connected to the controller.

Table 52: Event Notification and Recovery (NR) Threshold Classifications (Continued)

Threshold Value	Classification	Description
0A	Soft	Indicates either an unexpected condition detected by a controller software component (for example, protocol violations, host buffer access errors, internal inconsistencies, uninterpreted device errors, and so forth) or an intentional restart or shutdown of controller operation.
64	Informational	Indicates an event having little or no effect on proper controller or device operation.

Repair action

The Repair Action Code found at byte offset {9}33 indicates the recommended Repair Action Code assigned to the event. This value is used during symptom-directed diagnosis procedures to determine what Notification and Recovery (recommended repair) action to take upon reaching the NR threshold. For details about recommended Repair Action Codes, see the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161.

Event number

The event number is located at byte offset {10}34. Combining this number with the Component ID field value uniquely identifies the reported event.

Component ID

A Component ID is located at byte offset {11}35. This number uniquely identifies the software component that detected the event. For details about Component ID numbers, see the "ASC, ASCQ, Repair Action, and Component Identifier Codes" chapter that starts on page 161.

Table 53 contains the numerous Instance Codes, in ascending order, that might be issued by the controller fault management software.

Table 53: Instance Codes and Repair Action Codes (Sheet 1 of 30)

Instance Code	Description	Template	Repair Action Code
01010302	An unrecoverable hardware-detected fault occurred.	01	03
0102030A	An unrecoverable software inconsistency was detected or an intentional restart or shutdown of controller operation was requested.	01	03
01032002	Nonvolatile parameter memory component Error Detection Code (EDC) check failed; content of the component reset to default settings.	11	20
02020064	Disk bad block replacement attempt completed for a write within the user data area of the disk. Note that due to the way bad block replacement is performed on SCSI disk drives, information on the actual replacement blocks is not available to the controller and is, therefore, not included in the event report.	51	00
02032001	Journal Static Random Access Memory (SRAM) backup battery failure detected during system restart. The Memory Address field contains the starting physical address of the Journal SRAM.	12	20
02042001	Journal Static Random Access Memory (SRAM) backup battery failure detected during periodic recheck. The Memory Address field contains the starting physical address of the Journal SRAM.		
02052301	A processor interrupt was generated by the Cache A0 memory controller with an indication that the cache backup battery has failed or is low (needs charging). The Memory Address field contains the starting physical address of the Cache A0 memory.	12	23
02072201	The Cache AO memory controller failed testing performed by the cache diagnostics. The Memory Address field contains the starting physical address of the Cache A0 memory.	14	22
02082201	Changes to Cache A1.	14	22

Table 53: Instance Codes and Repair Action Codes (Sheet 2 of 30)

Instance Code	Description	Template	Repair Action Code
02090064	A data compare error was detected during the execution of a compare modified read or write command.	51	00
020B2201	Failed read test of a writeback metadata page residing in cache. Dirty writeback cached data exists and cannot be flushed to media. The dirty data is lost. The Memory Address field contains the starting physical address of the Cache A0 memory.	14	22
020C2201	Cache diagnostics have declared the cache bad during testing. The Memory Address field contains the starting physical address of the Cache A0 memory.	14	22
020D2401	The wrong write cache module is configured. The serial numbers do not match. Either the existing or the expected cache contains dirty writeback cached data. In this instance, the Memory Address, Byte Count, FX Chip Register, Memory Controller Register, and Diagnostic Register fields are undefined.	14	24
020E2401	The write cache module is missing. A cache is expected to be configured and contains dirty writeback cached data. In this instance, the Memory Address, Byte Count, FX Chip Register, Memory Controller Register, and Diagnostic Register fields are undefined.	14	24
02102401	The write cache modules are not configured properly for a dual-redundant configuration. One of the cache modules is not the same size to perform cache failover of dirty writeback cached data. In this instance, the Memory Address, Byte Count, FX Chip Register, Memory Controller Register, and Diagnostic Register fields are undefined.	14	24

Table 53: Instance Codes and Repair Action Codes (Sheet 3 of 30)

Instance Code	Description	Template	Repair Action Code
02110064	Disk bad block replacement attempt completed for a read within the user data area of the disk. Due to the way bad block replacement is performed on SCSI disk drives, information on the actual replacement blocks is not available to the controller and is, therefore, not included in the event report.	51	00
021A0064	Disk bad block replacement attempt completed for a write of controller metadata to a location outside the user data area of the disk. Due to the way bad block replacement is performed on SCSI disk drives, information on the actual replacement blocks is not available to the controller and is, therefore, not included in the event report.	41	00
021B0064	Disk bad block replacement attempt completed for a read of controller metadata from a location outside the user data area of the disk. Due to the way bad block replacement is performed on SCSI disk drives, information on the actual replacement blocks is not available to the controller and is, therefore, not included in the event report.	41	00
021D0064	Unable to lock the “other controller” cache in a write-cache failover attempt. Either a latent error could not be cleared on the cache or the “other controller” did not release the “other controller” cache. In this instance, the Memory Address, Byte Count, FX Chip Register, Memory Controller Register, and Diagnostic Register fields are undefined.	14	00
021E0064	The device, specified in the Device Locator field, was added to the RAIDset associated with the logical unit. The RAIDset is now in reconstructing state.	51	00
02280064	The device, specified in the Device Locator field, was added to the mirrorset associated with the logical unit. The new mirrorset member is now in Copying state.	51	00

Table 53: Instance Codes and Repair Action Codes (Sheet 4 of 30)

Instance Code	Description	Template	Repair Action Code
022C0064	The device, specified in the Device Locator field, has transitioned from Copying or Normalizing state to the Normal state.	51	00
022E0064	The device, specified in the Device Locator field, was converted to a mirrorset associated with the logical unit.	51	00
022F0064	The mirrored device specified in the Device Locator field was converted to a single device associated with the logical unit.	51	00
02383A01	The Cache B0 memory controller that resides on the other cache module failed testing performed by the cache diagnostics. This is the mirrored cache memory controller. The Memory Address field contains the starting physical address of the Cache B0 memory.	14	3A
02392201	Both the Cache B0 memory controller and Cache B1 memory controller, that reside on the other cache module, failed testing performed by the cache diagnostics. Data cannot be accessed in the primary cache or the mirror cache. The Memory Address field contains the starting physical address of the Cache A0 memory.	14	22
023E2401	Metadata residing in the controller and on the two cache modules disagree on the mirror node. In this instance, the Memory Address, Byte Count, FX Chip Register, Memory Controller Register, and Diagnostic Register fields are undefined.	14	24
023F2301	The cache backup battery covering the mirror cache is insufficiently charged. The Memory Address field contains the starting physical address of the Cache B1 memory.	12	23

Table 53: Instance Codes and Repair Action Codes (Sheet 5 of 30)

Instance Code	Description	Template	Repair Action Code
02402301	The cache backup battery covering the mirror cache was declared bad. Either the battery failed testing performed by the cache diagnostics during system startup or the battery was low (insufficiently charged) for longer than the expected duration. The Memory Address field contains the starting physical address of the Cache B1 memory.	12	23
02412401	Mirrored cache writes have been disabled. Either the primary or the mirror cache is bad, or the data is invalid and is not used. In this instance, the Memory Address, Byte Count, FX Chip Register, Memory Controller Register, and Diagnostic Register fields are undefined.	14	24
02422464	Cache failover attempt failed because the other cache was illegally configured with DIMMs. In this instance, the Memory Address, Byte Count, FX Chip Register, Memory Controller Register, and Diagnostic Register fields are undefined.	14	24
02492401	The write cache module, that is the mirror for the primary cache, is unexpectedly not present (missing). A cache is expected to be configured and the cache may contain dirty write cached data. In this instance, the Memory Address, Byte Count, FX Chip Register, Memory Controller Register, and Diagnostic Register fields are undefined.	14	24
024A2401	Mirroring is enabled and the primary write cache module is unexpectedly not present (missing). A cache is expected to be configured and the cache may contain dirty write cached data. In this instance, the Memory Address, Byte Count, FX Chip Register, Memory Controller Register, and Diagnostic Register fields are undefined.	14	24

Table 53: Instance Codes and Repair Action Codes (Sheet 6 of 30)

Instance Code	Description	Template	Repair Action Code
024B2401	Writeback caching is disabled either due to a cache or battery-related problem. The exact nature of the problem is reported by other Instance Codes. In this instance, the Memory Address, Byte Count, FX Chip Register, Memory Controller Register, and Diagnostic Register fields are undefined.	14	24
024F2401	This cache module is populated with DIMMs incorrectly. Cache metadata resident in the cache module indicates that unflushed write cache data exists for a cache size different than what is found present. In this instance, the Memory Address, Byte Count, FX Chip Register, Memory Controller Register, and Diagnostic Register fields are undefined.	14	24
0251000A	This command failed because the target unit is not online to the controller. The Information field of the device sense data contains the block number of the first block in error.	51	00
0253000A	The data supplied from the host for a data compare operation differs from the data on the disk in the specified block. The Information field of the device sense data contains the block number of the first block in error.	51	00
0254000A	The command failed due to a host data transfer failure. The Information field of the device sense data contains the block number of the first block in error.	51	00
0255000A	The controller was unable to successfully transfer data to the target unit. The Information field of the device sense data contains the block number of the first block in error.	51	00
0256000A	The write operation failed because the unit is data safety write-protected. The Information field of the device sense data contains the block number of the first block in error.	51	00

Table 53: Instance Codes and Repair Action Codes (Sheet 7 of 30)

Instance Code	Description	Template	Repair Action Code
0257000A	An attempt to reassign a bad disk block failed. The contents of the disk block are lost. The Information field of the device sense data contains the block number of the first block in error.	51	00
0258000A	This command was aborted prior to completion. The Information field of the device sense data contains the block number of the first block in error.	51	00
0259000A	The write operation failed because the unit is hardware write-protected. The Information field of the device sense data contains the block number of the first block in error.	51	00
025A000A	The command failed because the unit became inoperative prior to command completion. The Information field of the device sense data contains the block number of the first block in error.	51	00
025B000A	The command failed because the unit became unknown to the controller prior to command completion. The Information field of the device sense data contains the block number of the first block in error.	51	00
025C000A	The command failed because of a unit media format error. The Information field of the device sense data contains the block number of the first block in error.	51	00
025D000A	The command failed for an unknown reason. The Information field of the device sense data contains the block number of the first block in error.	51	00

Table 53: Instance Codes and Repair Action Codes (Sheet 8 of 30)

Instance Code	Description	Template	Repair Action Code
025F2201	Memory diagnostics performed during controller initialization detected an excessive number of memory errors (512 pages or more) on the primary cache memory. Diagnostics have not declared the cache failed, due to the isolated bad memory regions, but this is a warning to replace the cache as soon as possible in case of further degradation. The software performed the necessary error recovery as appropriate. In this instance, the Memory Address and Byte Count fields are undefined.	14	22
02603A01	Applies to mirrored cache memory.	14	3A
02613801	Memory diagnostics performed during controller initialization detected that the DIMM in location 1 failed on the cache module. In this instance, the Byte Count field in undefined.	14	38
02623801	Applies to location 2.		
02633801	Applies to location 3.		
02643801	Applies to location 4.		
02653C01	Memory diagnostics performed during controller initialization detected that the DIMM in location 3 on the “other controller’s” cache module (on mirrored cache) failed. Mirroring is disabled. In this instance, the Byte Count field is undefined.	14	3C
02663C01	Memory diagnostics performed during controller initialization detected that the DIMM in location 4 on the “other controller’s” cache module (on mirrored cache) failed. Mirroring is disabled. In this instance, the Byte Count field is undefined.	14	3C
02675201	The device, specified in the Device Locator field, was removed from the RAIDset associated with the logical unit. The removed device is now in the failedset. The RAIDset is now in a reduced state.	51	52

Table 53: Instance Codes and Repair Action Codes (Sheet 9 of 30)

Instance Code	Description	Template	Repair Action Code
0268530A	The device, specified in the Device Locator field, failed to be added to the RAIDset associated with the logical unit. The device remains in the spareset.	51	53
02695401	The device, specified in the Device Locator field, failed to be added to the RAIDset associated with the logical unit. The failed device was moved to the failedset.	51	54
026A5001	The RAIDset associated with the logical unit is inoperative.	51	50
026B0064	The RAIDset associated with the logical unit has transitioned from a Normal state to Reconstructing state.	51	00
026C0064	Applies to Reconstructing state to Normal state.	51	00
026D5201	The device, specified in the Device Locator field, was removed from the mirrorset associated with the logical unit. The removed device is now in the failedset.	51	52
026E0001	The device, specified in the Device Locator field, was reduced from the mirrorset associated with the logical unit. The nominal number of members in the mirrorset was decreased by one. The reduced device is now available for use.	51	00
026F530A	The device, specified in the Device Locator field, failed to be added to the mirrorset associated with the logical unit. The device remains in the spareset.	51	53
02705401	The device, specified in the Device Locator field, failed to be added to the mirrorset associated with the logical unit. The failed device was moved to the failedset.	51	54
02710064	The mirrorset associated with the logical unit has had the mirrorset nominal membership changed. The new nominal number of members for the mirrorset is specified in the device sense data Information field.	51	00
02725101	The mirrorset associated with the logical unit is inoperative.	51	51

Table 53: Instance Codes and Repair Action Codes (Sheet 10 of 30)

Instance Code	Description	Template	Repair Action Code
02730001	The device, specified in the Device Locator field, had a read error that was repaired with data from another mirrorset member.	51	00
02745A0A	The device, specified in the Device Locator field, had a read error. Attempts to repair the error with data from another mirrorset member failed due to lack of an alternate error-free data source.	51	5A
02755601	The device, specified in the Device Locator field, had a read error. Attempts to repair the error with data from another mirrorset member failed due to a write error on the original device. The original device is removed from the mirrorset.	51	56
02773D01	The mirrored cache is not being used because the data in the mirrored cache is inconsistent with the data in the primary cache. The primary cache contains valid data, so the controller is caching solely from the primary cache. The mirrored cache is declared `FAILED`, but this is not due to a hardware fault, only inconsistent data. Mirrored writes have been disabled until this condition is cleared. In this instance, the Memory Address, Byte Count, FX Chip Register, Memory Controller Register, and Diagnostic Register fields are undefined.	14	3D
02782301	The cache backup battery is not present. The Memory Address field contains the starting physical address of the Cache A0 memory.	12	23
02792301	The cache backup battery covering the mirror cache is not present. The Memory Address field contains the starting physical address of the Cache B1 memory.	12	23
027A2201	The Cache B0 memory controller failed cache diagnostics testing performed on the other cache during a cache failover attempt. The Memory Address field contains the starting physical address of the Cache B0 memory.	14	22

Table 53: Instance Codes and Repair Action Codes (Sheet 11 of 30)

Instance Code	Description	Template	Repair Action Code
027B2201	The Cache B1 memory controller failed cache diagnostics testing performed on the other cache during a cache failover attempt. The Memory Address field contains the starting physical address of the Cache B1 memory.	14	22
027C2201	The Cache B0 and Cache B1 memory controllers failed cache diagnostics testing performed on the other cache during a cache failover attempt. The Memory Address field contains the starting physical address of the Cache B0 memory.	14	22
027D5B01	The mirrorset associated with the logical unit is inoperative due to a disaster tolerance failsafe locked condition.	51	5B
027F2301	The cache backup battery is bad. The battery did not fully charge within the expected duration. The Memory Address field contains the starting physical address of the Cache A0 memory.	12	23
02825C64	The mirrorset associated with the logical unit has just had a membership change such that disaster tolerance failsafe error mode can now be enabled if desired.	51	5C
02864002	The controller has set the specified unit data safety write-protected due to an unrecoverable device failure that prevents writing cached data.	51	40
02872301	The cache backup battery has exceeded the maximum number of deep discharges allowed. Battery capacity may be below specified values. The Memory Address field contains the starting physical address of the Cache A0 memory.	12	23
02882301	The cache backup battery covering the mirror cache has exceeded the maximum number allowed for deep discharges. Battery capacity may be below specified values. The Memory Address field contains the starting physical address of the Cache B1 memory.	12	23

Table 53: Instance Codes and Repair Action Codes (Sheet 12 of 30)

Instance Code	Description	Template	Repair Action Code
02892301	The cache backup battery is near end of life. The Memory Address field contains the starting physical address of the Cache A0 memory.	12	23
028A2301	The cache backup battery covering the mirror cache is near end-of-life. The Memory Address field contains the starting physical address of the Cache B1 memory.	12	23
028B3801	Memory diagnostics performed during controller initialization detected that the DIMM in location 1 failed on the cache module. The failed DIMM should be replaced as soon as possible. Control structures have been moved to secondary memory and are now unprotected against additional memory failures. In this instance, the Byte Count field is undefined.	14	38
028C3801	Memory diagnostics performed during controller initialization detected that the DIMM in location 2 failed on the cache module. The failed DIMM should be replaced as soon as possible. Control structures have been moved to secondary memory and are now unprotected against additional memory failures. In this instance, the Byte Count field is undefined.	14	38
028D0064	The device, specified in the Device Locator field, was removed from the spareset into the failedset. The new nominal number of members for the spareset is specified in the device sense data Information field.	51	00
028F8901 02908901 02918901	The host command failed because the remote copy set went failsafe locked prior to command completion. The remote copy set is specified by the remote copy name field. The Information field of the device sense data contains the block number of the first block in error.	51	89

Table 53: Instance Codes and Repair Action Codes (Sheet 13 of 30)

Instance Code	Description	Template	Repair Action Code
02925D01	The device, specified in the Device Locator field, was removed from the spareset into the failedset; there are no devices left in the spareset. The new nominal number of members for the spareset is specified in the device sense data Information field.	51	5D
02931101	The UPS signaled a TMW before signaling an AC line failure. UPS signals are ignored until this condition clears.	12	11
0294000A	A requested block of data contains a forced error. A forced error occurs after a disk block is successfully reassigned, but the data in that block is lost. Rewriting the disk block clears the forced error condition. The Information field of the device sense data contains the block number of the first block in error.	51	00
0295000A	The Snapshot unit, indicated by the Unit Number field, is disabled. Reads to the unit fails. Reasons for disabling the Snapshot are a failure to copy to the temporary storageset, or no room on the temporary storageset to properly fail over the Snapshot.	51	00
02965E0A	The single member mirror has an error in its metadata space which could not be corrected. Backup data from the mirror as soon as possible.	51	5E
03010101	No command control structures available for disk operation. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	01
03022002	`SCSI INTERFACE CHIP` command timeout occurred during disk operation. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	20
03034002	Byte transfer timeout during disk operation. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	40

Table 53: Instance Codes and Repair Action Codes (Sheet 14 of 30)

Instance Code	Description	Template	Repair Action Code
03044402	SCSI bus errors during disk operation. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	44
03052002	Device port SCSI chip reported gross error during disk operation. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	20
03062002	Non-SCSI bus parity error during disk operation. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	20
03070101	Source driver programming error encountered during disk operation. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	01
03080101	Miscellaneous SCSI port driver coding error detected during disk operation. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	01
03094002	An unrecoverable disk drive error was encountered while performing work related to disk unit operations.	51	40
030C4002	A drive failed because a `TEST UNIT READY` command or a `READ CAPACITY` command failed.	51	40
030D000A	Drive was failed by a `MODE SELECT` command received from the host.	51	00
030E4002	Drive failed due to a deferred error reported by drive.	51	40
030F4002	Unrecovered read or write error.	51	40
03104002	No response from one or more drives.	51	40
0311430A	Nonvolatile memory and drive metadata indicate conflicting drive configurations.	51	43
0312430A	The synchronous transfer value differs between drives in the same storageset.	51	43
03134002	Maximum number of errors for this data transfer operation exceeded.	51	40
03144002	Drive reported recovered error without transferring all data.	51	40

Table 53: Instance Codes and Repair Action Codes (Sheet 15 of 30)

Instance Code	Description	Template	Repair Action Code
03154002	Data returned from drive is invalid.	51	40
03164002	REQUEST SENSE command to drive failed.	51	40
03170064	Illegal command for Passthrough mode.	51	00
03180064	Data transfer request error.	51	00
03194002	Premature completion of a drive command.	51	40
031A4002	Command timeout.	51	40
031B0101	Watchdog timer timeout.	51	01
031C4002	Disconnect timeout.	51	40
031D4002	Unexpected bus phase.	51	40
031E4002	Disconnect expected.	51	40
031F4002	ID message not sent by drive.	51	40
03204002	Synchronous negotiation error.	51	40
03214002	The drive unexpectedly disconnected from the SCSI bus.	51	40
03224002	Unexpected message.	51	40
03234002	Unexpected tag message.	51	40
03244002	Channel busy.	51	40
03254002	Message reject received on a valid message.	51	40
0326450A	The disk device reported, Vendor Unique SCSI Sense Data.	51	45
03270101	A disk-related error code was reported and was unknown to the fault management software. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	01
0328450A	The disk device reported, Standard SCSI Sense Data.	51	45
03324002	SCSI bus selection timeout.	Passthrough	40
03330002	Device power on reset.	Passthrough	00
03344002	Target assertion of REQ after WAIT DISCONNECT.	Passthrough	40

Table 53: Instance Codes and Repair Action Codes (Sheet 16 of 30)

Instance Code	Description	Template	Repair Action Code
03354002	During device initialization, a `TEST UNIT READY` command or a `READ CAPACITY` command to the device failed.	Passthrough	40
03364002	During device initialization, the device reported a deferred error.	Passthrough	40
03374002	During device initialization, the maximum number of errors for a data transfer operation was exceeded.	Passthrough	40
03384002	The `REQUEST SENSE` command to the device failed.	Passthrough	40
03394002	A command timeout occurred.	Passthrough	40
033A4002	A disconnect timeout occurred.	Passthrough	40
033B4002	An unexpected bus phase occurred.	Passthrough	40
033C4002	The device unexpectedly disconnected from the SCSI bus.	Passthrough	40
033D4002	Unexpected message.	Passthrough	40
033E4002	Message reject received on a valid message.	Passthrough	40
033F0101	No command control structures are available for the passthrough device operation.	Passthrough	01
03402002	The device port SCSI chip reported a gross error.	Passthrough	20
03410101	A miscellaneous SCSI port driver coding error occurred.	Passthrough	01
03420101	A passthrough device-related internal error code was reported and was not recognized by the fault management software.	Passthrough	01
03434002	During device initialization, the device reported unexpected `Standard SCSI Sense Data`.	Passthrough	40
03BE0701	The EMU for the cabinet, indicated by the Associated Port field, powered down the cabinet because there are fewer than four working power supplies present. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	07

Table 53: Instance Codes and Repair Action Codes (Sheet 17 of 30)

Instance Code	Description	Template	Repair Action Code
03BF0D01	The EMU for the cabinet, indicated by the Associated Port field, powered down the cabinet because the temperature has reached the allowable maximum. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	0D
03C00601	The EMU for the cabinet, indicated by the Associated Port field, powered down the cabinet because a fan was missing for more than 8 minutes. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	06
03C10F64	The EMU for the cabinet, indicated by the Associated Port field, allowed the cabinet to receive power because the number of power supplies is greater than or equal to 4. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	0F
03C20F64	The EMU for the cabinet, indicated by the Associated Port field, allowed the cabinet to receive power because the high temperature problem was fixed. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	0F
03C30F64	The EMU for the cabinet, indicated by the Associated Port field, allowed the cabinet to receive power because the fan that was missing was replaced. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	0F
03C80101	No command control structures are available for operation to a device that is unknown to the controller. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	01
03C92002	A `SCSI INTERFACE CHIP` command timeout occurred during operation to a device that is unknown to the controller. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	20

Table 53: Instance Codes and Repair Action Codes (Sheet 18 of 30)

Instance Code	Description	Template	Repair Action Code
03CA4002	A byte transfer timeout occurred during operation to a device that is unknown to the controller. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	40
03CB0101	A miscellaneous SCSI port driver coding error was detected during operation to a device that is unknown to the controller. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	01
03CC0101	An error code was reported that was unknown to the fault management software. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	01
03CD2002	The device port SCSI chip reported a gross error during operation to a device that is unknown to the controller. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	20
03CE2002	Non-SCSI bus parity error during operation to a device that is unknown to the controller. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	20
03CF0101	A source driver programming error was encountered during operation to a device that is unknown to the controller. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	01
03D04002	A failure occurred while attempting a `SCSI TEST UNIT READY` or `READ CAPACITY` command to a device. The device type is unknown to the controller. In this instance, the associated ASC and associated ASCQ fields are undefined (see the "Device Discovery Error report" section that starts on page 53).	41	40

Table 53: Instance Codes and Repair Action Codes (Sheet 19 of 30)

Instance Code	Description	Template	Repair Action Code
03D14002	The identification of a device does not match the configuration information. The actual device type is unknown to the controller. In this instance, the associated ASC, and associated ASCQ fields are undefined.	41	40
03D24402	SCSI bus errors occurred during device operation. The device type is unknown to the controller. In this instance, the associated ASC and associated ASCQ fields are undefined.	41	44
03D3450A	During device initialization, the device reported the SCSI sense key, no sense. This condition indicates that there is no specific sense key information to be reported for the designated logical unit. This would be the case for a successful command or a command that received check condition or command terminated status because one of the FM, EOM, or ILI bits is set to one in the sense data flags field.	41	45
03D4450A	During device initialization, the device reported the SCSI sense key, recovered error. This condition indicates that the last command completed successfully with some recovery action performed by the target.	41	45
03D5450A	During device initialization, the device reported the SCSI sense key, not ready. This condition indicates that the logical unit addressed cannot be accessed. Operator intervention may be required to correct this condition.	41	45

Table 53: Instance Codes and Repair Action Codes (Sheet 20 of 30)

Instance Code	Description	Template	Repair Action Code
03D6450A	During device initialization, the device reported the SCSI sense key, medium error. This condition indicates that the command stopped with a nonrecovered error condition that was probably caused by a flaw in the medium or an error in the recorded data. This sense key may also be returned if the target is unable to distinguish between a flaw in the medium and a specific hardware failure (`HARDWARE ERROR` sense key).	41	45
03D7450A	During device initialization, the device reported the SCSI sense key, hardware error. This condition indicates that the target detected a nonrecoverable hardware failure (for example, controller failure, device failure, parity error, and so forth) while performing the command or during a self-test.	41	45
03D8450A	During device initialization, the device reported the SCSI sense key, illegal request. This condition indicates that there is an illegal parameter in the command descriptor block or in the additional parameters supplied as data for some commands (`FORMAT UNIT`, `SEARCH DATA`, and so on). If the target detects an invalid parameter in the command descriptor block, the target stops the command without altering the medium. If the target detects an invalid parameter in the additional parameters supplied as data, the target may alter the medium. This sense key may also indicate that an invalid identify message was received.	41	45
03D9450A	During device initialization, the device reported the SCSI sense key, unit attention. This condition indicates that the removable medium was changed or the target reset.	41	45

Table 53: Instance Codes and Repair Action Codes (Sheet 21 of 30)

Instance Code	Description	Template	Repair Action Code
03DA450A	During device initialization, the device reported the SCSI sense key, data project. This condition indicates that a command that reads or writes the medium was attempted on a block that is protected from this operation. The read or write operation is not performed.	41	45
03DB450A	During device initialization, the device reported the SCSI sense key, blank check. This condition indicates that a write-once device encountered blank medium or format-defined end-of-data indication while reading or a write-once device encountered a non-blank medium while writing.	41	45
03DC450A	During device initialization, the device reported a SCSI vendor-specific sense key. This sense key is available for reporting vendor-specific conditions.	41	45
03DD450A	During device initialization, the device reported the SCSI sense key, copy aborted. This condition indicates that a `COPY`, `COMPARE`, or `COPY and VERIFY` command was aborted due to an error condition on the source device, the destination device, or both.	41	45
03DE450A	During device initialization, the device reported the SCSI sense key, aborted command. This condition indicates that the target aborted the command. The initiator may be able to recover by trying the command again.	41	45
03DF450A	During device initialization, the device reported the SCSI sense, key equal. This condition indicates that a search data command has satisfied an equal comparison.	41	45

Table 53: Instance Codes and Repair Action Codes (Sheet 22 of 30)

Instance Code	Description	Template	Repair Action Code
03E0450A	During device initialization, the device reported the SCSI sense key, volume overflow. This condition indicates that a buffered peripheral device has reached the end-of-partition and data not written to the medium may remain in the buffer. `RECOVERED BUFFER DATA` commands may be issued to read the unwritten data from the buffer.	41	45
03E1450A	During device initialization, the device reported the SCSI sense key, miscompare. This condition indicates that the source data did not match the data read from the medium.	41	45
03E2450A	During device initialization, the device reported a reserved SCSI sense key.	41	45
03E40F64	The EMU indicated that termination power is good on all ports. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	0F
03E58002	The EMU detected bad termination power on the indicated port. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	80
03EE0064	The EMU for the cabinet, indicated by the Associated Port field, is available. In this instance, the associated target, associated ASC, and the associated ASCQ are undefined.	41	00
03EF8301	The EMU for the cabinet, indicated by the Associated Port field, is unavailable. In this instance, the associated target, associated ASC, and the associated ASCQ are undefined.	41	83

Table 53: Instance Codes and Repair Action Codes (Sheet 23 of 30)

Instance Code	Description	Template	Repair Action Code
03F10502	The swap interrupt from the device port, indicated by the Associated Port field, cannot be cleared. All swap interrupts from all ports are disabled until corrective action is taken. If swap interrupts are disabled, neither controller front panel button presses nor removal or insertion of devices are detected by the controller. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	05
03F20064	Swap interrupts are cleared and re-enabled for all device ports. In this instance, the associated port, Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	00
03F30064	An asynchronous swap interrupt was detected by the controller for the device port, indicated by the Associated Port field. Possible reasons for this occurrence include: ■ Device insertion or removal. ■ Shelf power failure. ■ Swap interrupts re-enabled. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	00
03F40064	Device services had to reset the port to clear a bad condition. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	00
03F60402	The controller shelf is reporting a problem. This condition could mean one or all of the following: ■ If the shelf uses dual power supplies, one power supply failed. ■ One of the shelf cooling fans failed. ■ In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	04

Table 53: Instance Codes and Repair Action Codes (Sheet 24 of 30)

Instance Code	Description	Template	Repair Action Code
03F70401	The shelf, indicated by the Associated Port field, is reporting a problem. This condition could mean one or both of the following: ■ If the shelf uses dual power supplies, one power supply failed. ■ One of the shelf cooling fans failed. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	04
03F80701	The EMU detected one or more bad power supplies. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	07
03F90601	The EMU detected one or more bad fans. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	06
03FA0D01	The EMU detected an elevated temperature condition. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	0D
03FB0E01	The EMU detected an external air sense fault. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	0E
03FC0F01	The EMU-detected power supply fault is now fixed. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	0F
03FD0F01	The EMU-detected bad-fan fault is now fixed. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	0F
03FE0F01	The EMU-detected elevated temperature fault is now fixed. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	0F

Table 53: Instance Codes and Repair Action Codes (Sheet 25 of 30)

Instance Code	Description	Template	Repair Action Code
03FF0F01	The EMU-detected external air sense fault is now fixed. In this instance, the Associated Target, Associated ASC, and Associated ASCQ fields are undefined.	41	0F
07030B0A	The failover control detected a receive packet sequence number mismatch. The controllers are out of synchronization with each other and are unable to communicate. The Last Failure Code and Last Failure Parameters fields are undefined.	05	0B
07040B0A	The failover control detected a transmit packet sequence number mismatch. The controllers are not synchronized with each other and cannot communicate. In this instance, the Last Failure Code and Last Failure Parameters fields are undefined.	05	0B
07050064	The failover control received a last gasp message from the “other controller.” The “other controller” is expected to restart within a given time period. If the “other controller” does not, the “other controller” is reset with the kill line.	05	00
07060C01	The failover control detected that both controllers are acting as SCSI ID 6. Since IDs are determined by hardware, it is unknown which controller is the real SCSI ID 6. In this instance, the Last Failure Code and Last Failure Parameters fields are undefined.	05	0C
07070C01	The failover control detected that both controllers are acting as SCSI ID 7. Since IDs are determined by hardware, it is unknown which controller is the real SCSI ID 7. In this instance, the Last Failure Code and Last Failure Parameters fields are undefined.	05	0C
07080B0A	The failover control was unable to send a *keepalive* communication to the “other controller.” It is assumed that the “other controller” is inoperable or not started. In this instance, the Last Failure Code and Last Failure Parameters fields are undefined.	05	0B

Table 53: Instance Codes and Repair Action Codes (Sheet 26 of 30)

Instance Code	Description	Template	Repair Action Code
07090064	The failover control received a code load message from the “other controller” indicating that a new program image is being written onto the “other controller” PCMCIA card. During this process, communication does not occur between the controllers to keep them operative; however, “this controller” does not make the “other controller” inoperative.	05	00
0C00370A	Memory system error analysis is indicated in the information preserved during a previous last failure but no error conditions are indicated in the available Memory Controller Registers. The quadrant 0 memory controller (cache A0) registers content is supplied.	14	37
0C103E02	The quadrant 0 memory controller (cache A0) detected an Address Parity error.	14	3E
0C113E02	The quadrant 1 Memory controller (cache A1) detected an Address Parity error.	14	3E
0C123E02	The quadrant 2 memory controller (cache B0) detected an Address Parity error.	14	3E
0C133E02	The quadrant 3 memory controller (cache B1) detected an Address Parity error.	14	3E
0C203E02	The quadrant 0 memory controller (cache A0) detected a Data Parity error.	14	3E
0C213E02	The quadrant 1 memory controller (cache A1) detected a Data Parity error.	14	3E
0C223E02	The quadrant 2 memory controller (cache B0) detected a Data Parity error.	14	3E
0C233E02	The quadrant 3 memory controller (cache B1) detected a Data Parity error.	14	3E
0C303F02	The quadrant 0 memory controller (cache A0) detected a multibit ECC error.	14	3F
0C313F02	The quadrant 1 memory controller (cache A1) detected a multibit ECC error.	14	3F

Table 53: Instance Codes and Repair Action Codes (Sheet 27 of 30)

Instance Code	Description	Template	Repair Action Code
0C323F02	The quadrant 2 memory controller (cache B0) detected a multibit ECC error.	14	3F
0C333F02	The quadrant 3 memory controller (cache B1) detected a multibit ECC error.	14	3F
0C403E02	The quadrant 0 memory controller (cache A0) detected a firewall error.	14	3E
0C413E02	The quadrant 1 memory controller (cache A1) detected a firewall error.	14	3E
0C423E02	The quadrant 2 memory controller (cache B0) detected a firewall error.	14	3E
0C433E02	The quadrant 3 memory controller (cache B1) detected a firewall error.	14	3E
0E010064	A remote copy set was created specified by the Remote Copy Set Name field. The initiator unit of the remote copy set is specified by the initiator WWLID field.	90	00
0E020064	The remote copy set, specified by the Remote Copy Set Name field, was deleted by the operator.	90	00
0E030064	The logical unit, specified by the target WWLID, transitioned from the Normalizing or Copying state to the Normal state.	90	00
0E050064	The logical unit, specified by the target WWLID, was added to the remote copy set (specified by the Remote Copy Set Name field). The new target member is now in the Normalizing state.	90	00
0E068A01	The logical unit, specified by the target WWLID, was removed from the remote copy set (specified by the Remote Copy Set Name field).	90	8A
0E078A01	The logical unit, specified by the target WWLID, was removed from the remote copy set (specified by the Remote Copy Set Name field). The target was removed by the operator.	90	8A

Table 53: Instance Codes and Repair Action Codes (Sheet 28 of 30)

Instance Code	Description	Template	Repair Action Code
0E088864	The remote copy set, specified by the Remote Copy Set Name field, has just had a membership change such that Disaster Tolerance Failsafe Error mode can now be enabled if desired.	90	88
0E098901	The remote copy set, specified by the Remote Copy Set Name field, is inoperative due to a disaster tolerance failsafe locked condition.	90	89
0E0A8D01	The unit is unavailable to the host for the remote copy set, specified in the Remote Copy Set Name field. "This controller" cannot verify that a site failover did not occur; hence, it is not safe to present the WWLID.	90	8D
0E0B8E01	The unit is unavailable to the host for the remote copy set, specified in the Remote Copy Set Name field. "This controller" discovered a site failover occurrence; hence, "this controller" cannot present the WWLID.	90	8E
0E0C8C01 0E0E8B01	The copy was terminated due to a read failure on the initiator unit. The initiator unit is specified by the initiator WWLID field. Changes to write failure on the target unit occurred.	90 90	8C 8B
0E0F8B01	The copy was terminated due to a write failure on the target unit. The write failure was due to the links being down (target inaccessible). The copy restarts after at least one link is restored. The initiator unit is specified by the initiator WWLID field.	90	8B
0E100064	A link (connection) to a target controller was restored.	90	00
0E110064	The logical unit specified by the target WWLID transitioned from the Merging state to the Normal state.	90	00
0E120064	A link (connection) to a target controller was restored.	90	00
0E1A8B01	Write history log merge has encountered a write error on the remote target unit.	90	8B
0E1D8B01	Write history log merge detected the target unit has failed.	90	8B

Table 53: Instance Codes and Repair Action Codes (Sheet 29 of 30)

Instance Code	Description	Template	Repair Action Code
0E1E8C01	The asynchronous merge was terminated due to a read failure on the initiator unit.	90	8C
0E1F8B01	The asynchronous merge was terminated due to a write failure on the target unit.	90	8B
0E210064	The logical unit specified by the Target WWLID field has transitioned from the Normal state to the Write History Logging state due to a remote connection event (the target controllers are no longer accessible) or invocation of the `SUSPEND` CLI command.	90	00
0E220064	The logical unit specified by the target WWLID field has transitioned from the Logging state to the Merging state due to a remote connection event (the target controllers are inaccessible) or invocation of the `RESUME` CLI command.	90	00
0E238F01	The logical unit specified by the Log Unit Number field has failed.	90	8F
0E258F01	Write history logging encountered a write error on the log unit.	90	8F
0E260064	There is no more space left at the end of the log unit for write history logging.	90	00
0E278F01	Write history log merge encountered a read error on the log unit.	90	8F
0E288F01	The log unit failed with a media format error.	90	8F
0E290064	The log unit was reset because the specified target member was marked invalid. For instance, a site failover detected or a full member copy has started.	90	00
0E2A8F01	The logical unit specified by the Log Unit Number field is unknown or inoperative.	90	8F
0E2B0064	The log unit was reset due to loss of cached data for the write history log. The specified target member was marked for a full copy.	90	00
0E2C0064	A target member is being removed while write history logging is active.	90	00

Table 53: Instance Codes and Repair Action Codes (Sheet 30 of 30)

Instance Code	Description	Template	Repair Action Code
43010064	The host port protocol component detected that the "other controller" failed and that "this controller" has taken over the units specified in the extended sense data.	04	00
43020064	The host port protocol component detected that "this controller" has taken over (failed back) the units specified in the extended sense data.	04	00
43036A64	The host connection table has reached its maximum host connections. No new connections can be added until the host table is cleared of *stale* entries (inactive connections still listed on the connection table) or some host entries are deleted	A0	6A
82042002	A spurious interrupt was detected during the execution of a subsystem built-in self-test.	13	20
82052002	An unrecoverable error was detected during execution of the host port subsystem test. The system cannot communicate with the host.	13	20
82062002	An unrecoverable error was detected during execution of the UART and DUART subsystem test. This condition renders the console unusable and causes failover communications failure.	13	20
82072002	An unrecoverable error was detected during execution of the FX subsystem test.	13	20
820A2002	An unrecoverable error was detected during execution of the PCI9060ES test.	13	20
820B2002	An unrecoverable error was detected during execution of the device port subsystem built-in self-test. One or more of the device ports on the controller module has failed; some or all of the attached storage is no longer accessible on "this controller."	13	20

Last Failure Codes

6

This chapter describes Last Failure Codes (LFC) and explains how to handle them. An LFC is a number that uniquely describes an unrecoverable condition. The LFC is found at byte offset 104 to 107 and appears in only these two templates:

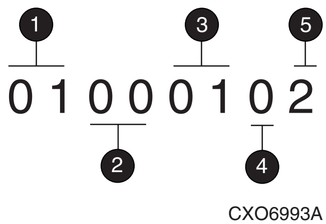
- Last Failure Event Sense Data Response template (Template 01) (see page 138).
- Failover Event Sense Data Response template (Template 05) (see page 142).

This chapter covers the following topics:

- Last Failure Code structure, page 212
- Last Failure Code format, page 213

Last Failure Code structure

Figure 26 shows the structure of an LFC. By fully understanding this structure, each code can be translated without using the *FMU*.



❶ Component ID Code
❷ Error Number
❸ Repair Action
❹ Restart Code and HW flag
❺ Parameter Count

Figure 26: Structure of a Last Failure Code

Last Failure Code format

The format of an LFC is shown in Table 54.

Table 54: Last Failure Code Format

offset	bit →	7	6	5	4	3	2	1	0
104		HW	Restart Code			Parameter Count			
105		Repair Action							
106		Error Number							
107		Component ID							

Note: Do not confuse the LFC with that of an Instance Code (see the "Instance Codes" chapter that starts on page 177). Both codes are similar in format, but they convey different information.

Parameter Count

The Parameter Count is located at byte offset 104, bits 0–3 and indicates the number of last failure parameters containing supplemental information supplied.

Restart Code

Located at byte offset 104, bits 4–6, the Restart Code describes the actions taken to restart the controller after the unrecoverable condition was detected. See Table 55 for available Restart Codes.

Table 55: Controller Restart Codes

Restart Code	Description
0	Full software restart.
1	No restart.
2	Automatic hardware restart.

Hardware and software flag

The hardware and software (HW) flag is located at byte offset 104, bit 7. If this flag is a 1, the unrecoverable condition is due to a hardware detected fault. If this flag is a 0, the unrecoverable condition is due to an inconsistency with the software, or a requested restart or shutdown of the controller.

Repair Action Code

The Repair Action Code at byte offset 105 indicates the recommended Repair Action Code assigned to the failure. This value is used during symptom-directed diagnosis procedures to determine what notification and recovery action to take. For details about recommended Repair Action Codes, see Table 49 on page 167.

Error Number

The Error Number is located at byte offset 106. Combining this number with the Component ID field value uniquely identifies the reported failure.

Component ID Code

The Component ID Code is located at byte offset 107. This code uniquely identifies the software component that reported the failure. For details about component ID codes, see the “ASC, ASCQ, Repair Action, and Component Identifier Codes’ chapter that starts on page 161.

Last Failure and Repair Action Codes

Table 56 lists Last Failure Codes that are issued from the controller. Codes are listed in ascending order.

Table 56: Last Failure Codes and Repair Action Codes (Sheet 1 of 55)

Last Failure Code	Description	Repair Action Code
01000100	Memory allocation failure during executive initialization.	01
01010100	An interrupt without any handler was triggered.	01
01020100	Entry on timer queue was not of type Associated Queue (AQ) or Blocking Queue (BQ).	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 2 of 55)

Last Failure Code	Description	Repair Action Code
01030100	Memory allocation for a facility lock failed.	01
01040100	Memory initialization called with invalid memory type.	01
01082004	The core diagnostics reported a fault: Last failure parameter [0] contains the error code value (same as flashing OCP LEDs error code). Last failure parameter [1] contains the address of the fault. Last failure parameter [2] contains the actual data value. Last failure parameter [3] contains the expected data value.	20
01090105	A non-maskable interrupt (NMI) occurred during `EXEC$BUGCHECK` processing: Last failure parameter [0] contains the executive flags value. Last failure parameter [1] contains the Return Instruction Pointer (RIP) from the NMI stack. Last failure parameter [2] contains the read diagnostic register 0 value. Last failure parameter [3] contains the FX Chip Control and Status Register (CSR) value. Last failure parameter [4] contains the System Information Page (SIP) LFC value.	01
010D0110	The System Information structure within the SIP was reset to default settings. The only known cause for this event is an Intel i960 processor hang caused by a reference to a memory region that is not implemented. After this occurs, controller modules equipped with an inactivity watchdog timer circuitry spontaneously reboots after the watchdog timer expires (within seconds of the hang). Controller modules not so equipped hang as indicated by the green LED on the OCP remaining in a Steady state.	01
010E0110	All structures contained in the SIP and the Last Failure entries have been reset to their default settings. This is a normal occurrence for the first power on following manufacture of the controller module and during the transition from one software version to another if the format of the SIP is different between the two versions. If this event is reported at any other time, follow the recommended Repair Action associated with this LFC.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 3 of 55)

Last Failure Code	Description	Repair Action Code
010F0110	All structures contained in the SIP and the Last Failure entries have been reset to their default settings as a result of certain controller manufacturing configuration activities. If this event is reported at any other time, follow the recommended Repair Action associated with this LFC.	01
01100100	Non-maskable interrupt entered but no Non-maskable interrupt pending. This is typically caused by an indirect call to address 0.	01
01110106	A bugcheck occurred during EXEC$BUGCHECK processing: Last failure parameter [0] contains the executive flags value. Last failure parameter [1] contains the RIP from the bugcheck call stack. Last failure parameter [2] contains the first SIP last failure parameter value. Last failure parameter [3] contains the second SIP last failure parameter value. Last failure parameter [4] contains the SIP LFC value. Last failure parameter [5] contains the EXEC$BUGCHECK call LFC value.	01
01140102	DEBUG, ASSUME, or ASSUME_LE macro executed. Last failure parameter [0] contains the address of the module name where the macro is located. Last failure parameter [1] contains the line number within the module where the macro is located. The high order byte of this value identifies the macro type: 0 = DEBUG, 1 = ASSUME, 2 = ASSUME_LE.	01
01150106	A bugcheck occurred before subsystem initialization completed: Last failure parameter [0] contains the executive flags value. Last failure parameter [1] contains the RIP from the bugcheck call stack. Last failure parameter [2] contains the first SIP last failure parameter value. Last failure parameter [3] contains the second SIP last failure parameter value. Last failure parameter [4] contains the SIP LFC value. Last failure parameter [5] contains the EXEC$BUGCHECK call LFC value.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 4 of 55)

Last Failure Code	Description	Repair Action Code
01170108	The Intel i960 processor reported a machine fault parity error while an NMI was being processed: Last failure parameter [0] contains the reserved value. Last failure parameter [1] contains the access type value. Last failure parameter [2] contains the access address value. Last failure parameter [3] contains the number of faults value. Last failure parameter [4] contains the process controls register (PC) value. Last failure parameter [5] contains the arithmetic controls register (AC) value. Last failure parameter [6] contains the fault type and subtype values. Last failure parameter [7] contains the RIP value.	01
01180105	A machine fault (parity error) occurred during `EXEC$BUGCHECK` processing: Last failure parameter [0] contains the executive flags value. Last failure parameter [1] contains the RIP from the machine fault stack. Last failure parameter [2] contains the read diagnostic register 0 value. Last failure parameter [3] contains the FX Chip CSR value. Last failure parameter [4] contains the SIP LFC value.	01
011B0108	The Intel i960 processor reported a machine fault nonparity error: Last failure parameter [0] contains the Fault Data (2) value. Last failure parameter [1] contains the Fault Data (1) value. Last failure parameter [2] contains the Fault Data (0) value. Last failure parameter [3] contains the Number of Faults value. Last failure parameter [4] contains the PC value. Last failure parameter [5] contains the AC value. Last failure parameter [6] contains the Fault Flags, Type and Subtype values. Last failure parameter [7] contains the RIP value (actual).	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 5 of 55)

Last Failure Code	Description	Repair Action Code
011C0011	Controller execution stopped through display of solid fault code in OCP LEDs. Upon receipt of this failure in a last gasp message, the “other controller” in a dual-redundant configuration inhibits assertion of the kill line. Last failure parameter [0] contains the OCP LED solid fault code value.	00
011D0100	Relocated zero (for example, C0000000) entered through call or branch.	01
018000A0	A power-fail interrupt occurred.	00
018600A0	A processor interrupt was generated with an indication that the “other controller” in a dual-redundant configuration asserted the kill line to disable “this controller.”	00
018700A0	A processor interrupt was generated with an indication that the (//) **Reset** button on the controller module was depressed.	00
018800A0	A processor interrupt was generated with an indication that the program card was removed.	00
018900A0	A processor interrupt was generated with an indication that the controller inactivity watchdog timer expired.	00

Table 56: Last Failure Codes and Repair Action Codes (Sheet 6 of 55)

Last Failure Code	Description	Repair Action Code
018F2087	A NMI interrupt was generated with an indication that a controller system problem occurred: Last failure parameter [0] contains the value of read diagnostic register 0. Last failure parameter [1] contains the value of read diagnostic register 1. Last failure parameter [2] contains PCI status. Bits 31::24 hold PCI FX engine (PCFX) PCI Status Command Register (PSCR) status and bits 15::08 hold PLX (bridge chip) PSCR status. Last failure parameter [3] contains the PCFX PCI Data or Address Line (PDAL) control and status register. Last failure parameter [4] contains the Intel bus (IBUS) address of error register. Last failure parameter [5] contains the previous PDAL address of error register. Last failure parameter [6] contains the current PDAL address of error register.	20
01902086	The PCI bus on the controller does not allow a master to initiate a transfer. Unable to provide further diagnosis of the problem: Last failure parameter [0] contains the value of read diagnostic register 0. Last failure parameter [1] contains the value of read diagnostic register 1. Last failure parameter [2] contains the value of read diagnostic register 2. Last failure parameter [3] contains the value of write diagnostic register 0. Last failure parameter [4] contains the value of write diagnostic register 1. Last failure parameter [5] contains the IBUS address of error register.	20

Table 56: Last Failure Codes and Repair Action Codes (Sheet 7 of 55)

Last Failure Code	Description	Repair Action Code
01910084	A cache module was inserted or removed: Last failure parameter [0] contains the value of the actual cache module A exists state. Last failure parameter [1] contains the value of the actual cache module B exists state. Last failure parameter [2] contains the value of the expected cache module A exists state. Last failure parameter [3] contains the value of the expected cache module B exists state.	00
01920186	Unable to read the FX because a device port or a host port locked the PDAL bus: Last failure parameter [0] contains the value of read diagnostic register 0. Last failure parameter [1] contains the value of read diagnostic register 1. Last failure parameter [2] contains the value of read diagnostic register 2. Last failure parameter [3] contains the value of write diagnostic register 0. Last failure parameter [4] contains the value of write diagnostic register 1. Last failure parameter [5] contains the IBUS address of error register.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 8 of 55)

Last Failure Code	Description	Repair Action Code
01932588	An error has occurred on the Cache Data and Address Line (CDAL): Last failure parameter [0] contains the value of read diagnostic register 0. Last failure parameter [1] contains the value of read diagnostic register 1. Last failure parameter [2] contains the value of write diagnostic register 0. Last failure parameter [3] contains the value of write diagnostic register 1. Last failure parameter [4] contains the IBUS address of the error register. Last failure parameter [5] contains the PCFX CDAL control and status register. Last failure parameter [6] contains the previous CDAL address of the error register. Last failure parameter [7] contains the current CDAL address of the error register.	25
01942088	Changes to PDAL.	20
01950188	An error has occurred that caused the FX to be reset, if not permissible: Last failure parameter [0] contains the value of read diagnostic register 0. Last failure parameter [1] contains the value of read diagnostic register 1. Last failure parameter [2] contains the value of write diagnostic register 0. Last failure parameter [3] contains the value of write diagnostic register 1. Last failure parameter [4] contains the IBUS address of the error register. Last failure parameter [5] contains the PCFX PDAL control and status register. Last failure parameter [6] contains the PCFX CDAL control and status register. Last failure parameter [7] contains the current PDAL address of the error register.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 9 of 55)

Last Failure Code	Description	Repair Action Code
01960186	The IBUS is inaccessible: Last failure parameter [0] contains the value of read diagnostic register 0. Last failure parameter [1] contains the value of read diagnostic register 1. Last failure parameter [2] contains the value of read diagnostic register 2. Last failure parameter [3] contains the value of write diagnostic register 0. Last failure parameter [4] contains the value of write diagnostic register 1. Last failure parameter [5] contains the IBUS address of the error register.	01
01970188	Software indicates all NMI causes cleared, but some remain: Last failure parameter [0] contains the value of read diagnostic register 0. Last failure parameter [1] contains the value of read diagnostic register 1. Last failure parameter [2] contains the value of read diagnostic register 2. Last failure parameter [3] contains the value of write diagnostic register 0. Last failure parameter [4] contains the value of write diagnostic register 1. Last failure parameter [5] contains the IBUS address of the error register. Last failure parameter [6] contains the PCFX PDAL control and status register. Last failure parameter [7] contains the PCFX CDAL control and status register.	01
01982087	The IBUS encountered a parity error: Last failure parameter [0] contains the value of read diagnostic register 0. Last failure parameter [1] contains the value of read diagnostic register 1. Last failure parameter [2] contains the value of read diagnostic register 2. Last failure parameter [3] contains the value of write diagnostic register 0. Last failure parameter [4] contains the value of write diagnostic register 1. Last failure parameter [5] contains the IBUS address of the error register. Last failure parameter [6] contains the RIP.	20

Table 56: Last Failure Codes and Repair Action Codes (Sheet 10 of 55)

Last Failure Code	Description	Repair Action Code
01992088	An error was detected by the PLX: Last failure parameter [0] contains the value of read diagnostic register 0. Last failure parameter [1] contains the value of read diagnostic register 1. Last failure parameter [2] contains the value of write diagnostic register 0. Last failure parameter [3] contains the value of write diagnostic register 1. Last failure parameter [4] contains the IBUS address of the error register. Last failure parameter [5] contains the PLX status register. Last failure parameter [6] contains the previous PDAL address of the error register. Last failure parameter [7] contains the RIP.	20
019A2093	Hardware port hardware failure—TACHYON: Last failure parameter [0] contains failed port number. Last failure parameter [1] contains Gluon status. Last failure parameter [2] contains TACHYON status.	20
02010100	Initialization code was unable to allocate enough memory to set up the send data descriptors.	01
02040100	Unable to allocate memory necessary for data buffers.	01
02050100	Unable to allocate memory for the free buffer array.	01
02080100	A call to `EXEC$ALLOCATE_MEM_ZEROED` failed to return memory after populating the disk read Device Work Descriptor (DWD) stack.	01
02090100	Changes to disk write.	01
020C0100	Changes to miscellaneous.	01
02100100	A call to `EXEC$ALLOCATE_MEM_ZEROED` failed to return memory after creating the device services state table.	01
02170100	Unable to allocate memory for the free node array.	01
021D0100	Unable to allocate memory for the free buffer array.	01
021F0100	Unable to allocate memory for Write Algorithm Request Packets (WARPs) and RAID Member Data (RMDs).	01
02210100	Invalid parameters in `CACHE$OFFER_META` call.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 11 of 55)

Last Failure Code	Description	Repair Action Code
02220100	No buffer found for CACHE$MARK_META_DIRTY call.	01
02270104	A callback from Device Services (DS) on a transfer request has returned a bad or illegal DWD status: Last failure parameter [0] contains the DWD Status. Last failure parameter [1] contains the DWD address. Last failure parameter [2] contains the Physical Unit Block (PUB) address. Last failure parameter [3] contains the Device Port.	01
022C0100	A READ_LONG operation was requested for a local buffer transfer. READ_LONG is not supported for local buffer transfers.	01
022D0101	A WRITE_LONG operation was requested for a local buffer. WRITE_LONG is not supported for local buffer transfers.	01
02380102	An invalid status was returned from CACHE$LOCK_READ( ): Last failure parameter [0] contains the DD address. Last failure parameter [1] contains the invalid status.	01
023A2084	A processor interrupt was generated by the controller FX, indicating an unrecoverable error condition: Last failure parameter [0] contains the FX CSR. Last failure parameter [1] contains the FX direct memory access (DMA) Indirect List Pointer register (DILP). Last failure parameter [2] contains the FX DMA Page Address Register (DADDR). Last failure parameter [3] contains the FX DMA Command and Control register (DCMD).	20
02440100	The logical unit mapping type was detected invalid in VA_SET_DISK_GEOMETRY( ).	01
02530102 02560102	An invalid status was returned from CACHE$LOOKUP_LOCK( ): Last failure parameter [0] contains the DD address. Last failure parameter [1] contains the invalid status.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 12 of 55)

Last Failure Code	Description	Repair Action Code
02570102	An invalid status was returned from `VA$XFER( )` during an operation: Last failure parameter [0] contains the DD address. Last failure parameter [1] contains the invalid status.	01
025A0102	An invalid status was returned from `CACHE$LOOKUP_LOCK( )`: Last failure parameter [0] contains the DD address. Last failure parameter [1] contains the invalid status.	01
02690102	An invalid status was returned from `CACHE$OFFER_WRITE_DATA( )`: Last failure parameter [0] contains the DD address. Last failure parameter [1] contains the invalid status.	01
027B0102	An invalid status was returned from `VA$XFER( )` in a complex ACCESS operation: Last failure parameter [0] contains the DD address. Last failure parameter [1] contains the invalid status.	01
027D0100	Unable to allocate memory for a Failover Control Block.	01
027E0100	Unable to allocate memory for a Failover Control Block.	01
027F0100	Unable to allocate memory for a Failover Control Block.	01
02800100	Unable to allocate memory for a Failover Control Block.	01
02840100	Unable to allocate memory for the XNode array.	01
02860100	Unable to allocate memory for the Fault Management Event Information Packet used by the Cache Manager in generating error logs to the host.	01
02880100	Invalid Failover control (FOC) message in `CMFOC_SND_CMD`.	01
028A0100 028B0100	Invalid return status from `DIAG$CACHE_MEMORY_TEST`.	01
028C0100	Invalid error status given to `CACHE_FAIL`.	01
028E0100	Invalid Device Correlation Array (DCA) state detected in `INIT_CRASHOVER`.	01
02910100	Invalid metadata combination detected in `BUILD_RAID_NODE`.	01
02920100	Unable to handle that many bad dirty pages (exceeded `MAX_BAD_DIRTY`). Cache memory is bad.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 13 of 55)

Last Failure Code	Description	Repair Action Code
02930100	There was no free or freeable buffer to convert bad metadata or to borrow a buffer during failover of bad dirty data.	01
02940100	A free device correlation array entry could not be found during writeback cache failover.	01
02950100	Invalid DCA state detected in `START_CRASHOVER`.	01
02960100	Invalid DCA state detected in `START_FAILOVER`.	01
02965E0A	A bad block was detected on the mirrorset metadata region, and the requested addition of a new member to the mirrorset could not be completed.	5E
02970100	Invalid DCA state detected in `INIT_FAILOVER`.	01
02990100	A free RAID correlation array entry could not be found during writeback cache failover.	01
029A0100	Invalid cache buffer metadata detected while scanning the buffer metadata array. Found a page containing dirty data but the corresponding device correlation array entry does exist.	01
029D0100	Invalid metadata combination detected in `BUILD_BAD_RAID_NODE`.	01
029F0100	The Cache Manager software has insufficient resources to handle a buffer request pending.	01
02A00100	Value-added (VA) Change state is trying to change device affinity and the cache has data for this device.	01
02A10100	Pubs not one when transportable.	01
02A20100	Pubs not one when transportable.	01
02A30100	No available data buffers. If the cache module exists, then this is true after testing the whole cache. Otherwise, no buffers are allocated from buffer memory on the controller module.	01
02A40100	A call to `EXEC$ALLOCATE_MEM_ZEROED` failed to return memory after allocating VA Transfer Descriptors (VAXDs).	01
02A50100	Changes to DILPs occurred.	01
02A60100	A call to `EXEC$ALLOCATE_MEM_ZEROED` failed to return memory after allocating Change State Work Items.	01
02A70100	Changes to VA Request Items.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 14 of 55)

Last Failure Code	Description	Repair Action Code
02A90100	Too many pending `FOC$SEND` requests by the Cache Manager. Code is not designed to handle more than one `FOC$SEND` pending because there is no reason to expect more than one pending.	01
02AA0100	An invalid call was made to `CACHE$DEALLOCATE_CLD`. Either that device had dirty data, or it was bound to a RAIDset.	01
02AB0100	An invalid call was made to `CACHE$DEALLOCATE_SLD`. A RAIDset member either had dirty data or writeback already turned on.	01
02AC0100	An invalid call was made to `CACHE$DEALLOCATE_SLD`. The RAIDset still has data (strip nodes).	01
02AE0100	The mirrorset member count and individual member states are inconsistent. Discovered during a mirrorset write or erase.	01
02AF0102	An invalid status was returned from `VA$XFER( )` in a write operation: Last failure parameter [0] contains the DD address. Last failure parameter [1] contains the invalid status.	01
02B00102	An invalid status was returned from `VA$XFER()` in an erase operation: Last failure parameter[0] contains the DD address. Last Failure Parameter[1] contains the invalid status.	01
02B10100	A mirrorset read operation was received and the round robin selection algorithm found no Normal members in the mirrorset. Internal inconsistency.	01
02B20102	An invalid status was returned from `CACHE$LOCK_READ` during a mirror copy operation: Last failure parameter [0] contains the DD address. Last failure parameter [1] contains the invalid status.	01
02B30100	`CACHE$CHANGE_MIRROR_MODE` invoked illegally (cache bad, dirty data still resident in the cache.)	01
02B90100	Invalid code loop count attempting to find the cache ID blocks.	01
02BD0100	A mirrorset metadata online operation found no Normal members in the mirrorset. Internal inconsistency.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 15 of 55)

Last Failure Code	Description	Repair Action Code
02BE0100	No free pages in the other cache. In performing mirror cache failover, a bad page was found, and an attempt was made to recover the data from the good copy (primary or mirror), but no free good page was found on the other cache to which the data is copied.	01
02BF0100	The `REPORT_ERROR` routine encountered an unexpected failure status returned from `DIAG$LOCK_AND_TEST_CACHE_B`.	01
02C00100	The `COPY_BUFF_ON_THIS` routine expected the given page to be marked bad but was not.	01
02C10100	The `COPY_BUFF_ON_OTHER` routine expected the given page to be marked bad but was not.	01
02C30100	The `CACHE$CREATE_MIRROR` was invoked by `C_SWAP` under unexpected conditions (for example, the “other controller” is not inoperative but is in a Bad Lock state).	01
02C60100	Mirroring transfer found Cache List Descriptor (CLD) with Writeback state off.	01
02C70100	Adverse bad block replacement (BBR) offsets for active shadowset, detected on write.	01
02C80100	Bad BBR offsets for an active shadowset detected on read.	01
02C90100	Illegal call made to `CACHE$PURGE_META` since the storageset was not quiesced.	01
02CA0100	Illegal call made to `VA$RAID5_META_READ` while another read (of metadata) is already in progress on the same strip.	01
02CB0000	A restore of the configuration was done. This cleans up and restarts with the new configuration.	00
02CC0100	On an attempt to allocate a cache node that is not allowed to fail, no freeable cache node was found.	01
02D00100	Not all `ALTER_DEVICE` requests from `VA_SAVE_CONFIG` completed within the timeout interval.	01
02D30100	The controller has insufficient memory to allocate enough data structures used to manage metadata operations.	01
02D60100	An invalid storage set type was specified for metadata initialization.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 16 of 55)

Last Failure Code	Description	Repair Action Code
02D90100	Bad CLD pointer passed `SETWB` routine.	01
02DA0100	A fatal logic error occurred while trying to restart a stalled data transfer stream.	01
02DB0100	A call to `EXEC$ALLOCATE_MEM_ZEROED` failed to return memory while populating the disk read PCI XOR engine (PCX) DWD stack.	01
02DC0100	Changes to disk write.	01
02DD0102	The VA state change deadman timer expired, and at least one VSI was still interlocked. Last failure parameter [0] contains the `NV_INDEX`. Last failure parameter [1] contains the address of the locking routine.	01
02DD0104	The VA state change deadman timer expired, and at least one VSI was still interlocked. Last Failure Parameter[0] contains the `NV_INDEX`. Last Failure Parameter[1] contains the address of the locking routine. Last Failure Parameter[2] bit mask of resource waiters. Last Failure Parameter[3] contains the address of the waiter routine.	
02DE0100	An attempt to allocate memory for a `NULL PUB` failed to get the memory.	01
02DF0101	License identified in last failure parameter [0] was not forced valid.	01
02E00180	Mirror functionality is broken.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 17 of 55)

Last Failure Code	Description	Repair Action Code
02E11016	After attempting to restore saved configuration information, data for two unrelated controllers was found. The restore code is unable to determine which disk contains the correct information. The port, target, and LUN information for the two disks is contained in the parameter list. Remove the disk containing the incorrect information, reboot the controller, and issue the `SET THIS_CONTROLLER INITIAL_CONFIGURATION` command. After the controller restarts, the proper configuration is loaded: Last failure parameter [0] contains the first disk port. Last failure parameter [1] contains the first disk target. Last failure parameter [2] contains the first disk LUN. Last failure parameter [3] contains the second disk port. Last failure parameter [4] contains the second disk target. Last failure parameter [5] contains the second disk LUN.	10
02E20100	An attempt to allocate a `VA_CS_WORK` item from the `S_VA_FREE_CS_WORK_QUEUE` failed.	01
02E30100	An attempt to allocate a free VA Request (VAR) failed.	01
02E40100	An attempt to allocate a free VAR failed.	01
02E50100	An attempt to allocate a free VAR failed.	01
02E60100	An attempt to allocate a free VAR failed.	01
02E70100	An attempt to allocate a free VAR failed.	01
02E80100	An attempt to allocate a free VAR failed.	01
02E90100	An attempt to allocate a free VAR failed.	01
02EA0100	An attempt to allocate a free VAR failed.	01
02EB0100	An attempt to allocate a free metadata WARP failed.	01
02EC0101	An online request was received for a unit while both controllers had dirty data for the unit. The crash allows the surviving controller to copy over all of the dirty data. Last failure parameter [0] contains the `NV_INDEX` of the unit.	01
02ED0100	On an attempt to allocate a Buffer Descriptor Block (BDB), that is not allowed to fail, no freeable BDB was found.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 18 of 55)

Last Failure Code	Description	Repair Action Code
02EE0102	A CLD is already allocated when it should be free: Last failure parameter [0] contains the requesting entity. Last failure parameter [1] contains the CLD index.	01
02EF0102	A CLD is free when it should be allocated: Last failure parameter [0] contains the requesting entity. Last failure parameter [1] contains the CLD index.	01
02F00100	The controller has insufficient free resources for the configuration restore process to obtain a facility lock.	01
02F10102	The configuration restore process encountered an unexpected nonvolatile parameter store format. The process cannot restore from this version: Last failure parameter [0] contains the version found. Last failure parameter [1] contains the expected version.	01
02F20100	The controller has insufficient free resources for the configuration restore process to release a facility lock.	01
02F34083	A device read operation failed during the configuration restore operation. The controller is crashed to prevent possible loss of saved configuration information on other functioning devices: Last failure parameter [0] contains the disk port. Last failure parameter [1] contains the disk target. Last failure parameter [2] contains the disk LUN.	40
02F44083	The calculated error detection code on the saved configuration information is bad. The controller is crashed to prevent destruction of other copies of the saved configuration information. Remove the device with the bad information and retry the operation: Last failure parameter [0] contains the disk port. Last failure parameter [1] contains the disk target. Last failure parameter [2] contains the disk LUN.	40

Table 56: Last Failure Codes and Repair Action Codes (Sheet 19 of 55)

Last Failure Code	Description	Repair Action Code
02F54083	The device saved configuration information selected for the restore process is from an unsupported controller type. Remove the device with the unsupported information and retry the operation: Last failure parameter [0] contains the disk port. Last failure parameter [1] contains the disk target. Last failure parameter [2] contains the disk LUN.	40
02F60103	An invalid modification to the NO_INTERLOCK VSI flag was attempted: Last failure parameter [0] contains the NV_INDEX of the config on which the problem was found. Last failure parameter [1] contains the modification flag. Last failure parameter [2] contains the current value of the NO_INTERLOCK flag. If the modification flag is 1, then an attempt was being made to set the NO_INTERLOCK flag, and the NO_INTERLOCK flag was not clear at the time. If the modification flag is 0, then an attempt was being made to clear the NO_INTERLOCK flag, and the NO_INTERLOCK flag was not set (== 1) at the time.	01
02F70100	During power on testing, one or more device ports (SCSI) were found to be bad. Due to a problem in the SYM53C770 chip, the diagnostic may occasionally fail the port even though the hardware is OKAY. A power on should clear up the problem. If the port is actually broken, logic to detect a loop that repeatedly causes the same bugcheck causes a halt.	01
02F80103	An attempt was made to bring a unit online while the Cache Manager says that a member CLD was not in the appropriate state: Last failure parameter [0] contains the NV_INDEX of the config on which the problem was found. Last failure parameter [1] contains the map type of that configuration. Last failure parameter [2] contains the value from CACHE$CHECK_CID that was not acceptable.	01
02F90100	A call to EXEC$ALLOCATE_MEM_ZEROED failed to return memory while allocating structures for read ahead caching.	01
02FA0100	A Read Ahead Data Descriptor (RADD) is inconsistent.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 20 of 55)

Last Failure Code	Description	Repair Action Code
02FB2084	A processor interrupt was generated by the controller FX engine, indicating an unrecoverable error condition: Last failure parameter [0] contains the FX CSR. Last failure parameter [1] contains the FX DILP. Last failure parameter [2] contains the FX DADDR. Last failure parameter [3] contains the FX DCMD.	20
02FB2086	A processor interrupt was generated by the controller's XOR engine (FX), indicating an unrecoverable error condition: Last failure parameter[0] contains the FX CSR. Last failure parameter[1] contains the FX DMA DILP. Last failure parameter[2] contains the FX DMA DADDR. Last failure parameter[3] contains the FX DMA DCMD. Last failure parameter[4] contains the FX DMA DIR. Last failure parameter[5] contains the FX active flag.	20
02FC0180	The FX detected a compare error for data that was identical. Previously this error has always occurred due to a hardware problem.	01
02FD0100	The controller has insufficient free memory to restore saved configuration information from disk.	01
02FE0105	A field in the VSI was not cleared while an attempt was made to clear the interlock: Last failure parameter [0] contains the nonvolatile (NV) index of the VSI on which the problem was found. Last failure parameter [1] contains the contents of the Enable_change field of the VSI, that should be zero. Last failure parameter [2] contains the contents of the Desired_state field of the VSI, that should be zero. Last failure parameter [3] contains the contents of the Completion_routine field of the VSI, that should be zero. Last failure parameter [4] contains the contents of the Open_requests field of the VSI, that should be zero.	01
03010100	Failed request for port-specific scripts memory allocation.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 21 of 55)

Last Failure Code	Description	Repair Action Code
03020101	Invalid SCSI direct-access device OpCode in miscellaneous command DWD: Last failure parameter [0] contains the SCSI command OpCode.	01
03040101	Invalid SCSI CDROM device OpCode in miscellaneous command DWD: Last failure parameter [0] contains the SCSI command OpCode.	01
03060101	Invalid SCSI device type in PUB: Last failure parameter [0] contains the SCSI device type.	01
03070101	Invalid Command Description Block (CDB) Group Code detected during create of miscellaneous command DWD: Last failure parameter [0] contains the SCSI command OpCode.	01
03080101	Invalid SCSI optical memory device OpCode in miscellaneous command DWD: Last failure parameter [0] contains the SCSI command OpCode.	01
03090101	Failed request for allocation of PCI miscellaneous block: Last failure parameter [0] contains the failed DWD command class.	01
030A0100	Error DWD not found in port `IN_PROC_Q`.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 22 of 55)

Last Failure Code	Description	Repair Action Code
030B0188	A dip error was detected after PCB_BUSY was set: Last failure parameter [0] contains the Process Controls Block (PCB) PORT_PTR value. Last failure parameter [1] contains the new info NULL-SSTAT0-DSTAT-ISTAT. Last failure parameter [2] contains the PCB copy of the device port DMA Byte Counter (DBC) register. Last failure parameter [3] contains the PCB copy of the device port DMA Next Address Data (DNAD) register. Last failure parameter [4] contains the PCB copy of the device port DMA SCRIPTS Pointer (DSP) register. Last failure parameter [5] contains the PCB copy of the device port DMA SCRIPTS Pointer Saved (DSPS) register. Last failure parameter [6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers. Last failure parameter [7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.	01
031E0100	Cannot find IN_ERROR DWD on in-process queue.	01
031F0100	Either DWD_PTR is NULL or bad value in dsps.	01
03280100	SCSI CDB contains an invalid group code for a transfer command.	01
03290100	The required Event Information Packet (EIP) or DWD were not supplied to the Device Services error logging code.	01
032B0100	A DWD was supplied with a NULL PUB pointer.	01
03320101	An invalid code was passed to the error recovery thread in the ERROR_STAT field of the PCB: Last failure parameter [0] contains the PCB ERROR_STAT code.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 23 of 55)

Last Failure Code	Description	Repair Action Code
03330188	A parity error was detected by a device port while sending data onto the SCSI bus: Last failure parameter [0] contains the PCB `PORT_PTR` value. Last failure parameter [1] contains the PCB copy of the device port TEMP register. Last failure parameter [2] contains the PCB copy of the device port DBC register. Last failure parameter [3] contains the PCB copy of the device port DNAD register. Last failure parameter [4] contains the PCB copy of the device port DSP register. Last failure parameter [5] contains the PCB copy of the device port DSPS register. Last failure parameter [6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers. Last failure parameter [7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 24 of 55)

Last Failure Code	Description	Repair Action Code
03370108	A device port detected an illegal script instruction: Last failure parameter [0] contains the PCB `PORT_PTR` value. Last failure parameter [1] contains the PCB copy of the device port TEMP register. Last failure parameter [2] contains the PCB copy of the device port DBC register. Last failure parameter [3] contains the PCB copy of the device port DNAD register. Last failure parameter [4] contains the PCB copy of the device port DSP register. Last failure parameter [5] contains the PCB copy of the device port DSPS register. Last failure parameter [6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers. Last failure parameter [7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 25 of 55)

Last Failure Code	Description	Repair Action Code
03380188	A device port device statistics (DSTAT) register contains multiple asserted bits, or an invalidly asserted bit, or both: Last failure parameter [0] contains the PCB `PORT_PTR` value. Last failure parameter [1] contains the PCB copy of the device port TEMP register. Last failure parameter [2] contains the PCB copy of the device port DBC register. Last failure parameter [3] contains the PCB copy of the device port DNAD register. Last failure parameter [4] contains the PCB copy of the device port DSP register. Last failure parameter [5] contains the PCB copy of the device port DSPS register. Last failure parameter [6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers. Last failure parameter [7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 26 of 55)

Last Failure Code	Description	Repair Action Code
03390108	An unknown interrupt code was found in a device port DSPS register: Last failure parameter [0] contains the PCB PORT_PTR value. Last failure parameter [1] contains the PCB copy of the device port TEMP register. Last failure parameter [2] contains the PCB copy of the device port DBC register. Last failure parameter [3] contains the PCB copy of the device port DNAD register. Last failure parameter [4] contains the PCB copy of the device port DSP register. Last failure parameter [5] contains the PCB copy of the device port DSPS register. Last failure parameter [6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers. Last failure parameter [7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.	01
033C0101	An invalid code was seen by the error recovery thread in the ER_FUNCT_STEP field of the PCB: Last failure parameter [0] contains the PCB ER_FUNCT_STEP code.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 27 of 55)

Last Failure Code	Description	Repair Action Code
033E0108	An attempt was made to restart a device port at the Save Data Pointer (SDP) Data Buffer Descriptor (DBD): Last failure parameter [0] contains the PCB `PORT_PTR` value. Last failure parameter [1] contains the PCB copy of the device port TEMP register. Last failure parameter [2] contains the PCB copy of the device port DBC register. Last failure parameter [3] contains the PCB copy of the device port DNAD register. Last failure parameter [4] contains the PCB copy of the device port DSP register. Last failure parameter [5] contains the PCB copy of the device port DSPS register. Last failure parameter [6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers. Last failure parameter [7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 28 of 55)

Last Failure Code	Description	Repair Action Code
033F0108	An EDC error was detected on a read of a soft-sectored device path not yet implemented: Last failure parameter [0] contains the PCB `PORT_PTR` value. Last failure parameter [1] contains the PCB copy of the device port TEMP register. Last failure parameter [2] contains the PCB copy of the device port DBC register. Last failure parameter [3] contains the PCB copy of the device port DNAD register. Last failure parameter [4] contains the PCB copy of the device port DSP register. Last failure parameter [5] contains the PCB copy of the device port DSPS register. Last failure parameter [6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers. Last failure parameter [7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.	01
03410101	Invalid SCSI device type in PUB: Last failure parameter [0] contains the PUB SCSI device type.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 29 of 55)

Last Failure Code	Description	Repair Action Code
03450188	A Master Data Parity Error was detected by a port: Last failure parameter [0] contains the PCB `PORT_PTR` value. Last failure parameter [1] contains the PCB copies of the device port DCMD/DBC registers. Last failure parameter [2] contains the PCB copy of the device port DNAD register. Last failure parameter [3] contains the PCB copy of the device port DSP register. Last failure parameter [4] contains the PCB copy of the device port DSPS register. Last failure parameter [5] contains the PCB copies of the device port DSTAT/SSTAT0/SSTAT1/SSTAT2 registers. Last failure parameter [6] contains the PCB copies of the device port DFIFO/ISTAT/SBCL/RESERVED registers. Last failure parameter [7] contains the PCB copies of the device port SIST0/SIST1/SXFER/SCNTL3 registers.	01
03470100	Insufficient memory available for target block allocation.	01
03480100	Insufficient memory available for device port info block allocation.	01
03490100	Insufficient memory available for automatic configuration buffer allocation.	01
034A0100	Insufficient memory available for PUB allocation.	01
034B0100	(No description)	01
034C0100	Insufficient memory available for static structure allocation.	01
034D0100	DS init DWDs exhausted.	01
034E2080	Diagnostics report all device ports are broken.	20
034F0100	Insufficient memory available for reselect target block allocation.	01
03500100	Insufficient memory available for command disk allocation.	01
03520100	A failure resulted after an attempt was made to allocate a DWD for use by DS Command Data Interface (CDI).	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 30 of 55)

Last Failure Code	Description	Repair Action Code
03530102	A DWD with an illegal address was found: Last failure parameter [0] contains the bad DWD pointer. Last failure parameter [1] contains the corresponding PCB pointer.	01
035A0100	Invalid SCSI message byte passed to DS.	01
035B0100	Insufficient DWD resources available for SCSI message passthrough.	01
03640100	Processing `RUN_SWITCH` disabled for `LOGDISK` associated with the "other controller."	01
03650100	Processing PUB unblock for `LOGDISK` associated with the "other controller."	01
03660100	No memory available to allocate PUB to tell the "other controller" of reset to one if its LUNs.	01
03670100	Changes to a Bad Block Replacement (BBR) occurred.	01
036F0101	Either `SEND_SDTR` or `SEND_WDTR` flag set in a non-miscellaneous DWD: Last failure parameter [0] contains the invalid command class type.	01
03780181	In `DS_GET_RESUME_ADDR`, the buffer address is non-longword aligned for FX access: Last failure parameter [0] contains the re-entry bad address value.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 31 of 55)

Last Failure Code	Description	Repair Action Code
03790188	A PCI bus fault was detected by a device port: Last failure parameter [0] contains the PCB PORT_PTR value. Last failure parameter [1] contains the PCB copy of the device port TEMP register. Last failure parameter [2] contains the PCB copy of the device port DBC register. Last failure parameter [3] contains the PCB copy of the device port DNAD register. Last failure parameter [4] contains the PCB copy of the device port DSP register. Last failure parameter [5] contains the PCB copy of the device port DSPS register. Last failure parameter [6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers. Last failure parameter [7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.	01
03820100	Failed request for mapping table memory allocation.	01
03830100	Failed request for SYM53C875 PCI block memory allocation.	01
03850101	DS_ALLOC_MEM called with invalid memory type: Last failure parameter [0] contains the invalid memory type.	01
03860100	DS_ALLOC_MEM was unable to get requested memory allocated; NULL pointer returned.	01
038C0100	Insufficient memory available for completion of DWD array allocation.	01
03980100	Failed to allocate expandable EMU static work structures.	01
03990100	Failed to allocate expandable EMU work entry.	01
039A0100	Failed to allocate expandable EMU FOC work entry.	01
039B0100	EMU request work queue corrupted.	01
039C0100	EMU response work queue corrupted.	01
039D0100	EMU work queue corrupted.	01
039E0100	EMU FOC request work queue corrupted.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 32 of 55)

Last Failure Code	Description	Repair Action Code
039F0100	EMU FOC response work queue corrupted.	01
03A08093	A configuration or hardware error was reported by the EMU: Last failure parameter [0] contains the solid OCP pattern that identifies the type of problem encountered. Last failure parameter [1] contains the cabinet ID reporting the problem. Last failure parameter [2] contains the SCSI Port number where the problem exists (if port-specific).	80
03A28193	The EMU reported that the terminator power was out of range: Last failure parameter [0] contains a bit mask indicating SCSI port number(s) where the problem exists for cabinet 0. Bit 0 set indicates SCSI port 1, bit 1 set indicates SCSI port 2, and so forth. Last failure parameter [1] contains a bit mask indicating SCSI port number(s) where the problem exists for cabinet 2. Last failure parameter [2] contains a bit mask indicating SCSI port number(s) where the problem exists for cabinet 3.	81
03A30790	The EMU in cabinet 0 is performing an emergency shutdown because fewer than four functioning power supplies exist.	07
03A40D90	The EMU in cabinet 0 is performing an emergency shutdown because it has determined that the temperature is above the maximum limit.	0D
03A50690	The EMU in cabinet 0 is performing an emergency shutdown because a fan was missing for more than 8 minutes.	06
04010101	The requester ID component of the Instance Code passed to `FM$REPORT_EVENT` is larger than the maximum allowed for this environment: Last failure parameter [0] contains the Instance Code value.	01
04020102	The requester error table index passed to `FM$REPORT_EVENT` is larger than the maximum allowed for this requester: Last failure parameter [0] contains the Instance Code value. Last failure parameter [1] contains the requester error table index value.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 33 of 55)

Last Failure Code	Description	Repair Action Code
04030102	The Unit State Block (USB) index supplied in the EIP is larger than the maximum number of USBs: Last failure parameter [0] contains the Instance Code value. Last failure parameter [1] contains the USB index value.	01
04040103	The Event log format found in `V_FM_TEMPLATE_TABLE` is not supported by the Fault Manager. The bad format was discovered while trying to fill in a supplied EIP: Last failure parameter [0] contains the Instance Code value. Last failure parameter [1] contains the format code value. Last failure parameter [2] contains the requester error table index value.	01
04050100	The Fault Manager could not allocate memory for its EIP buffers.	01
040A0100	The caller of `FM$CANCEL_SCSI_DE_NOTIFICATION` passed an address of a deferred error notification routine that does not match the address of any routines for which deferred error notification is enabled.	01
040E0100	`FM$ENABLE_DE_NOTIFICATION` was called to enable deferred error notification, but the specified routine was already enabled to receive deferred error notification.	01
040F0102	The `EIP->GENERIC.MSCP1.FLGS` field of the EIP passed to `FM$REPORT_EVENT` contains an invalid flag. Last failure parameter [0] contains the Instance Code value. Last failure parameter [1] contains the value supplied in the `EIP->GENERIC.MSCP1.FLGS` field.	01
04100101	Unexpected template type found during `FMU_DISPLAY_ERRLOG` processing. Last failure parameter [0] contains the unexpected template value.	01
04110101	Unexpected Instance Code found during `FMU_MEMERR_REPORT` processing. Last failure parameter [0] contains the unexpected Instance Code value.	01
04120101	`CLIB$SDD_FAO` call failed: Last failure parameter [0] contains the failure status code value.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 34 of 55)

Last Failure Code	Description	Repair Action Code
04140103	The template value found in the EIP is not supported by the Fault Manager. The bad template value was discovered while trying to build an ESD: Last failure parameter [0] contains the Instance Code value. Last failure parameter [1] contains the template code value. Last failure parameter [2] contains the requester error table index value.	01
04170102	The template value found in the ESD is not supported by the Fault Manager. The bad template value was discovered while trying to translate an ESD into an EIP: Last failure parameter [0] contains the Instance Code value. Last failure parameter [1] contains the template code value.	01
04180103	The `COMMON$MEM_FAIL_TEMPLATE` template found in the ESD is not supported by the Fault Manager. The bad template was discovered while trying to translate an ESD into an EIP: Last failure parameter [0] contains the Instance Code value. Last failure parameter [1] contains the template code value. Last failure parameter [2] contains the template flags value.	01
04190100	A NULL pointer was found for the `TARGET_CTX`, or the `TARGET_CTX` has an invalid type.	01
05010100	In `RECURSIVE_NONCONFLICT` could not get enough memory for scanning the keyword tables for configuration name conflicts.	01
06010100	The DUART was unable to allocate enough memory to establish a connection to the CLI.	01
06020100	A port other than terminal port A was referred to by a set terminal characteristics command. This is illegal.	01
06030100	A Diagnostic Utility Protocol (DUP) question or default question message type was passed to the DUART driver, but the pointer to the input area to receive the response to the question was NULL.	01
06040100	Attempted to detach unattached maintenance terminal.	01
06050100	Attempted output to unattached maintenance terminal.	01
06060100	Attempted input from output only maintenance terminal service.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 35 of 55)

Last Failure Code	Description	Repair Action Code
06070100	The DUART was unable to allocate enough memory for its input buffers	01
06080000	Controller was forced to restart due to entry of a **Ctrl+K** character on the maintenance terminal.	00
07010100	All available slots in the FOC notify table are filled.	01
07020100	`FOC$CANCEL_NOTIFY( )` was called to disable notification for a return that did not have notification enabled.	01
07030100	Unable to start the Failover control timer before main loop.	01
07040100	Unable to restart the Failover control timer.	01
07050100	Unable to allocate flush buffer.	01
07060100	Unable to allocate active receive Failover Control Block (FCB).	01
07070100	The “other controller” made this inoperative, but could not assert the kill line because nindy is on or in debug. It made this inoperative now.	01
07080000	The “other controller” failed, so this one must fail too.	00
07090100	A call to `EXEC$ALLOCATE_MEM_ZEROED` failed to return memory while allocating VA Request Items.	01
08010101	A remote state change was received from the FOC thread that Nonvolatile FOC (NVFOC) does not recognize: Last failure parameter [0] contains the unrecognized state value.	01
08020100	No memory could be allocated for a NVFOC information packet.	01
08030101	Work received on the `S_NVFOC_BQUE` did not have a NVFOC work ID: Last failure parameter [0] contains the ID type value that was received on the NVFOC work queue.	01
08040101	Unknown work value received by the `S_NVFOC_BQUE`: Last failure parameter [0] contains the unknown work value.	01
08060100	A write command was received while the NV memory was not locked.	01
08070100	A write to NV memory was received while not locked.	01
08080000	The “other controller” requested “this controller” to restart.	00
08090010	The “other controller” requested “this controller” to shut down.	00

Table 56: Last Failure Codes and Repair Action Codes (Sheet 36 of 55)

Last Failure Code	Description	Repair Action Code
080A0000	The "other controller" requested "this controller" to self-test.	00
080B0100	Could not get enough memory to build a FCB to send to the remote routines on the "other controller."	01
080C0100	Could not get enough memory for FCBs to receive information from the "other controller."	01
080D0100	Could not get enough memory to build a FCB to reply to a request from the "other controller."	01
080E0101	An out-of-range receiver ID was received by the NVFOC communication utility (master send to slave send ACK): Last failure parameter [0] contains the bad ID value.	01
080F0101	An out-of-range receiver ID was received by the NVFOC communication utility (received by master): Last failure parameter [0] contains the bad ID value.	01
08100101	A call to `NVFOC$TRANSACTION` had a From field (ID) that was out of range for the NVFOC communication utility: Last failure parameter [0] contains the bad ID value.	01
08110101	NVFOC tried to defer more than one FOC send: Last failure parameter [0] contains the master ID of the connection that had the multiple delays.	01
08140100	Could not allocate memory to build a workblock to queue to the NVFOC thread.	01
08160100	A request to clear the remote configuration was received, but the memory was not locked.	01
08170100	A request to read the next configuration was received, but the memory was not locked.	01
08180100	Could not get enough memory for Firmware Licensing System (FLS) FCBs to receive information from the "other controller."	01
08190100	An unlock command was received while the NV memory was not locked.	01
081A0100	Unable to allocate memory for remote work.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 37 of 55)

Last Failure Code	Description	Repair Action Code
081B0101	Bad remote work received on remote work queue: Last failure parameter [0] contains the ID type value that was received on the NVFOC remote work queue.	01
081C0101	Bad member management work received: Last failure parameter [0] contains the bad member management value that was detected.	01
081D0000	In order to go into Mirrored Cache mode, the controllers must be restarted.	00
081E0000	In order to go into Non-mirrored Cache mode, the controllers must be restarted.	00
081F0000	An `FLM$INSUFFICIENT_RESOURCES` error was returned from a Facility Lock Manager (FLM) lock or unlock call.	00
08200000	Expected restart so the `WRITE_INSTANCE` may recover from a configuration mismatch.	00
08210100	Unable to allocate memory to setup NVFOC lock and unlock notification routines.	01
09010100	Unable to acquire memory to initialize the FLM structures.	01
09640101	Work that was not FLM work was found on the FLM queue. Bad format is detected or the formatted string overflows the output buffer: Last failure parameter [0] contains the work found.	01
09650101	Work that was not FLM work was found on the FLM queue: Last failure parameter [0] contains the structure found.	01
09670101	Local FLM detected an invalid facility to act upon: Last failure parameter [0] contains the facility found.	01
09680101	Remote FLM detected an error and requested the local controller to restart: Last failure parameter [0] contains the reason for the request.	01
09C80101	Remote FLM detected an invalid facility to act upon: Last failure parameter [0] contains the facility found.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 38 of 55)

Last Failure Code	Description	Repair Action Code
09C90101 09CA0101	Remote FLM detected an invalid work type: Last failure parameter [0] contains the work type found.	01
09CB0012	Remote FLM detected that the “other controller” has a facility lock manager at an incompatible revision level (with “this controller”) : Last failure parameter [0] contains the “this controller” FLM revision. Last failure parameter [1] contains the “other controller” FLM revision.	00
0A020100	`ILF$CACHE_READY` unable to allocate necessary DWDs.	01
0A030100	`ILF$CACHE_READY BUFFERS_OBTAINED >` non-zero stack entry count.	01
0A040100	`ILF$CACHE_READY DWD` overrun.	01
0A050100	`ILF$CACHE_READY DWD` underrun.	01
0A060100	`ILF$CACHE_READY` found buffer marked for “other controller.”	01
0A070100	`CACHE$FIND_LOG_BUFFERS` returned continuation handle > 0.	01
0A080100	Not processing a bugcheck.	01
0A090100	No active DWD.	01
0A0A0100	Current entry pointer is not properly aligned.	01
0A0B0100	Next entry pointer is not properly aligned.	01
0A0E0100	Active DWD is not a disk write DWD as expected.	01
0A0F0100	New active DWD is not a disk write DWD as expected.	01
0A100100 0A120100 0A130100	Data buffer pointer is not properly aligned.	01
0A140100	New entry pointer is not properly aligned.	01
0A150100	New entry record type is out of range.	01
0A190102	`ILF_DEPOPULATE_DWD_TO_CACHE` first page guard check failed: Last failure parameter [0] contains the DWD address value. Last failure parameter [1] contains the buffer address value.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 39 of 55)

Last Failure Code	Description	Repair Action Code
0A1C0102 0A1D0102 0A1E0102	ILF$LOG_ENTRY page guard check failed: Last failure parameter [0] contains the DWD address value. Last failure parameter [1] contains the buffer address value.	01
0A1F0100	ILF_REBIND_CACHE_BUFFS_TO_DWDS found duplicate buffer for current DWD.	01
0A200101	Unknown bugcheck code passed to ILF_CACHE_INTERFACE_CRASH: Last failure parameter [0] contains the unknown bugcheck code value.	01
0A210100	ILF_REBIND_CACHE_BUFFS_TO_DWDS found buffer type not IDX_ILF.	01
0A220100	ILF_REBIND_CACHE_BUFFS_TO_DWDS found buffer DBD index too big.	01
0A240100	ILF_CHECK_HANDLE_ARRAY_EDC found IHIEA EDC bad.	01
0A250100	ILF_GET_NEXT_HANDLE found no free IHIEA entry.	01
0A260100	ILF_REMOVE_HANDLE could not find specified handle.	01
0A270100	ILF_DEPOPULATE_DWD_TO_CACHE could not find handle for first buffer.	01
0A280100	ILF_DEPOPULATE_DWD_TO_CACHE buffer handle does not match current handle.	01
0A290100	ILF_REBIND_CACHE_BUFFS_TO_DWDS could not find handle for DWD being rebound.	01
0A2B0100	ILF$CACHE_READY Cache Manager did not return multiple of DWD DBDs worth of buffers.	01
0A2C0100	ILF_REBIND_CACHE_BUFFS_TO_DWDS page guard check failed.	01
0A2D0100	ILF_POPULATE_DWD_FROM_CACHE buffer stack entry zero or not page aligned.	01
0A2E0100	ILF_POPULATE_DWD_FROM_CACHE returned buffer type not IDX_ILF.	01
0A2F0100	ILF_REBIND_CACHE_BUFFS_TO_DWDS buffer stack entry not page aligned.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 40 of 55)

Last Failure Code	Description	Repair Action Code
0A300100	`ILF_DEPOPULATE_DWD_TO_CACHE` buffer stack entry zero or not page aligned.	01
0A310100	`ILF_DISTRIBUTE_CACHE_DWDS` active handle count not as expected.	01
0A320102	`ILF$LOG_ENTRY`, page guard check failed: Last failure parameter [0] contains the DWD address value. Last failure parameter [1] contains the buffer address value.	01
0A330100	`ILF_OUPUT_ERROR, MESSAGE_KEEPER_ARRAY` full.	01
0A340101	`ILF_OUTPUT_ERROR`, no memory for message display. Last failure parameter [0] contains the message address value.	01
0A360100	Duplicate entry found in `ILF_POPULATE_DWD_FROM_CACHE` buffer stack.	01
0A370100	Duplicate entry found in `ILF_REBIND_CACHE_BUFFS_TO_DWDS` buffer stack.	01
0A380108	Next entry was partially loaded: Last failure parameter [0] contains the next entry address. Last failure parameter [1] contains the next entry record type. Last failure parameter [2] contains the next entry time of day (TOD) flag. Last failure parameter [3] contains the next entry interrupt (INT) flag. Last failure parameter [4] contains the next entry byte count. Last failure parameter [5] contains the next entry TOD ticks. Last failure parameter [6] contains the next entry TOD days. Last failure parameter [7] contains the next entry data start.	01
0B010010	Due to an operator request, the controller nonvolatile configuration information was reset to its initial state.	00
0B020100	The controller has insufficient free memory to allocate a Configuration Manager work item needed to perform the requested configuration reset.	01
0B030100	Changes to restore.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 41 of 55)

Last Failure Code	Description	Repair Action Code
0B040100	The controller has insufficient free memory to allocate a Configuration Manager WWL work item needed to perform the requested WWLID change.	01
0B050100	More requests to `WWL$NOTIFY` have been made than can be supported.	01
0B060100	A call to `WWL$UPDATE` resulted in the need for another World-Wide LUN ID slot, and no free slots were available.	01
0B070100	The controller has insufficient free memory to allocate a Configuration Manager Device Nickname (DNN) work item needed to perform the requested DNN change.	01
0B080100	More requests to `DNN$NOTIFY` have been made than can be supported.	01
0B090100	A call to `DNN$UPDATE` resulted in the need for another DNN slot, and no free slots were available.	01
OB0A0100	Unable to find any unused storage groups	01
OB0B0100	Unable to find any unused partition group.	01
OB0C0100	Unable to allocate memory to use for communication with the DT manager.	01
0D000011	The EMU firmware returned a bad status after directed to power off. Last failure parameter [0] contains the value of the bad status.	00
0E000100	`VA$ENABLE_NOTIFICATION` failed with insufficient resources at controller initialization time.	01
0E010102	An invalid status was returned from `CACHE$LOCK_READ` during a remote copy: Last failure parameter [0] contains the DD address. Last failure parameter [1] contains the invalid status.	01
0E020100	Unable to allocate memory for the Fault Management Event Information Packet used in generating error logs to the host.	01
0E030100	Unable to allocate memory for a Failover Control Block.	01
0E040100	Unable to allocate memory for a Failover Control Block.	01
0E050100	Unable to allocate memory for a Failover Control Block.	01
0E060100	Unable to allocate memory for a Failover Control Block.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 42 of 55)

Last Failure Code	Description	Repair Action Code
0E096980	This controller detected a failed link during repetitive signalling, or *heartbeat*, to a remote target. The ”other controller” has a good link to the remote target. In order to resume operations to that remote target, “this controller” is restarted to fail over the initiator unit to the “other controller.”	69
0E0A6980	A remote copy write has failed all recovery attempts on “this controller.” As part of further error recovery, “this controller” is restarted, to force the initiator unit over to the “other controller” so the remote copy can be retried.	69
0E0B6980	“This controller” detected a failed link upon restarting dual-redundant controllers. The “other controller” has a good link to the remote target. In order to resume operations to that remote target, “this controller” is restarted to fail over the initiator unit to the “other controller.”	69
0E0C0101	Unrecognized request to perform Write History Log (WHL) operation on other controller. Last Failure Parameter [0] contains operation request.	01
0E0D0101	Unrecognized WHL operation ID received from other controller. Last Failure Parameter [0] contains an operation ID.	01
0E0E0101	An illegal failover request was given to the WHL request handler. Last Failure Parameter [0] contains a failover request.	01
0E0F0101	An illegal failover response was given to the WHL response handler. Last Failure Parameter [0] contains a failover response.	01
0E100100	The Write History Log failover control had a bad send count.	01
0E110100	Unable to allocate memory for WHL DBs	01
0E120100	Unable to allocate memory for WHL HTBs.	01
0E130100	Unable to allocate memory for WHL HTBs.	01
0E140100	Unable to allocate memory for WHL HTBs.	
0E150101	Unable to allocate memory for WHL metadata. Last Failure Parameter [0] contains response failure code.	01
0E160100	An illegal WHL lock state was detected.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 43 of 55)

Last Failure Code	Description	Repair Action Code
0E170101	An invalid sense key was detected during WHL processing. Last Failure Parameter [0] contains unexpected sense key.	01
0E180100	Call to `VA$ENABLE_NOTIFICATION( )` failed due to `INSUFFICIENT_RESOURCES`.	01
0E199001	"This controller" comes up misconfigured to avoid a recursive bug check. Issue the `SET NOFAILOVER` CLI command on the "other controller," and then issue a "`SET MULTI COPY=THIS`" from the "other controller." **Note:** Note that there is a unit that is inoperative. Take corrective steps to resolve that unit.	90
12000103 12010103	Two values found not equal: Last failure parameter [0] contains the ASSUME instance address. Last failure parameter [1] contains the first variable value. Last failure parameter [2] contains the second variable value. Changes to equal.	01
12020103 12030103 12040103 12050103	First value found greater or equal: Last failure parameter [0] contains the `ASSUME` instance address. Last failure parameter [1] contains the first variable value. Last failure parameter [2] contains the second variable value. Changes to greater. Changes to smaller or equal. Changes to smaller.	01
12060102	`VSI_PTR->NO_INTERLOCK` not set: Last failure parameter [0] contains the `ASSUME` instance address. Last failure parameter [1] contains `NV_INDEX` value.	01
12070102	`VSI_PTR->ALLOCATED_THIS` not set: Last failure parameter [0] contains the `ASSUME` instance address. Last failure parameter [1] contains `NV_INDEX` value.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 44 of 55)

Last Failure Code	Description	Repair Action Code
12080102	VSI_PTR->CS_INTERLOCKED not set: Last failure parameter [0] contains the ASSUME instance address. Last failure parameter [1] contains NV_INDEX value.	01
12090102	Unhandled switch case: Last failure parameter [0] contains the ASSUME instance address. Last failure parameter [1] contains NV_INDEX value.	01
120A0103	WARP expand point value does not match blocks: Last failure parameter [0] contains the WARP address. Last failure parameter [1] contains the WARP expand point value. Last failure parameter [2] contains the WARP blocks value.	01
120B2380	Forced restart of the controller upon a cache battery failure. This is done only under conditions that require the restart for error recovery.	23
120C0101	Found invalid UPS Descriptor state: Last failure parameter[0] contains UPS Descriptor state.	01
120D0100	Initialization code was unable to allocate enough memory to set up the send data descriptors for local buffer transfers.	01
120E0310	An image upgrade that updated the cache metadata version failed because the cache module hardware for non-volatile metadata contained therein was bad. Either “this controller” cache hardware failed (or for the case of mirrored cache, the “other controller” cache hardware), or the cache metadata was in an Invalid state. Restart “this controller” with the pre-upgrade image, and issue the SHOW THIS_CONTROLLER CLI command to determine whether the hardware failed or the metadata was in the Invalid Cache state. Fix the condition and verify that it is fixed before restarting the upgrade procedure from the beginning.	03
120F0310	An image upgrade that updated the cache metadata version failed because the cache module holds dirty data that needs to be flushed prior to image swap. Restart “this controller” with the pre-upgrade image, and restart the upgrade procedure from the beginning. This procedure causes dirty data to be flushed before the new image is installed.	03

Table 56: Last Failure Codes and Repair Action Codes (Sheet 45 of 55)

Last Failure Code	Description	Repair Action Code
12100310	An image upgrade that updated the cache metadata version failed because the cache module held dirty data. This was likely caused by deviating from the required upgrade procedure (by not properly verifying the integrity of the system prior to the image swap or by swapping hardware components as part of the procedure). The dirty data was permanently cleared from the cache. Restart "this controller" with the pre-upgrade image. If either the `SHOW THIS_CONTROLLER INVALID_CACHE` or `SHOW UNIT` lost data conditions are found, they must be cleared.	03
12110310	An image upgrade that updated the cache metadata version failed because the cache module held dirty data. This was likely caused by deviating from the required upgrade procedure (by not properly verifying the integrity of the system prior to the image swap or by swapping hardware components as part of the procedure). The dirty data was permanently cleared from the cache. Restart "this controller" with the pre-upgrade image. If either the `SHOW THIS_CONTROLLER INVALID_CACHE` or `SHOW UNIT` lost data conditions are found, they must be cleared.	03
12120108	The internal consistency checks have determined that the requested transfer is invalid. The parameters contain transfer specific flags and values intended for use by the software developers: Last failure parameter[0] contains the DD address. Last failure parameter[1] contains the DD LBN. Last failure parameter[2] contains the DD DBD count. Last failure parameter[3] contains the DD VA flags. Last failure parameter[4] contains the HTB VA flags. Last failure parameter[5] contains the HTB LBA. Last failure parameter[6] contains the HTB block count. Last failure parameter[7] contains the USB unit number or the HTB OpCode.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 46 of 55)

Last Failure Code	Description	Repair Action Code
12130108	An internal consistency check has diagnosed an FX chip hang. The resulting reboot resets the chip. The parameters contain values intended for use by the software developers: Last failure parameter[0] contains the FX DMA time check. Last failure parameter[1] contains the FX DMA active flag. Last failure parameter[2] contains the FX DMA step. Last failure parameter[3] contains the FX DMA XOR count. Last failure parameter[4] contains the FX DMA Zero count. Last failure parameter[5] contains the FXWI state. Last failure parameter[6] contains the FX wait queue count. Last failure parameter[7] contains the FX ring queue count.	01
12140100	An attempt to allocate a free VAR failed.	01
12150100	An attempt to allocate a free VAR failed.	01
20010100	The action for work on the CLI queue should be `CLI_CONNECT`, `CLI_COMMAND_IN` or `CLI_PROMPT`. If it is not one of these three, a bugcheck results.	01
20020100	The Formatted ASCII Output (FAO) returned a non-successful response. This response happens only if a bad format is detected or the formatted string overflows the output buffer.	01
20030100	The type of work received on the CLI work queue was not of type CLI.	01
20060100	A work item of an unknown type was placed on the CLI SCSI virtual terminal thread work queue by the CLI.	01
20080000	“This controller” requested “this controller” to restart.	00
20090010	“This controller” requested “this controller” to shut down.	00
200A0000	“This controller” requested “this controller” to self-test.	00
200B0100	Could not get enough memory for FCBs to receive information from the “other controller.”	01
200D0101	`DS$PORT_BLOCKED` failed to return a false status (which signals that nothing is blocked): Last failure parameter [0] contains the port number 1–6 (or port 1–2 on the HSG60); waiting to be unblocked.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 47 of 55)

Last Failure Code	Description	Repair Action Code
200E0101	While traversing the structure of a unit, a `CONFIG_INFO` node was discovered with an unrecognized structure type: Last failure parameter [0] contains the structure type number that was unrecognized.	01
200F0101	A `CONFIG_INFO` node was discovered with an unrecognized structure type: Last failure parameter [0] contains the structure type number that was unrecognized.	01
20100101	A `CONFIG_INFO` of type `VA_MA_DEVICE` had an unrecognized SCSI device type: Last failure parameter [0] contains the SCSI device type number that was unrecognized.	01
20110100	An attempt to allocate memory so that the CLI prompt messages could be deleted failed.	01
20120101	While traversing the structure of a unit, a `CONFIG_INFO` node was discovered with an unrecognized structure type: Last failure parameter [0] contains the structure type number that was unrecognized.	01
20130101	While traversing the structure of a unit, the device was of an unrecognized type: Last failure parameter [0] contains the SCSI device type that was unrecognized.	01
20160000	In order to go into Mirrored Cache mode, the controllers must be restarted.	00
20160100	Unable to allocate resources needed for the CLI local program.	01
20170000	In order to go into Nonmirrored Cache mode, the controllers must be restarted.	00
20190010	A cache state of a unit remains `WRITE_CACHE_UNWRITTEN_DATA`. The unit is not online; thus this state would be valid only for a very short period of time.	00
201A0100	An attempt to allocate memory so that a CLI prompt message could be reformatted failed.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 48 of 55)

Last Failure Code	Description	Repair Action Code
201B0100 201C0100	Insufficient resources to get memory to lock CLI. Changes to unlock.	01
20200100	`CLI$ALLOCATE_STRUCT( )` could not obtain memory for a new `NVFOC_RW_REMOTE_NVMEM` structure.	01
20220020	This controller requested this subsystem to power off.	00
20230000	A restart of both controllers is required after exiting Multibus Failover mode.	00
20260000	With "*SET FAILOVER COPY=OTHER*," the controller to which the configuration is copied is automatically restarted by this bugcheck.	00
20640000 20650000	Nindy was turned on. Changes to off.	00
20692010	To enter Dual-redundant mode, both controllers must be of the same type.	20
206A0000 206B0010	Controller restart forced by `DEBUG CRASH REBOOT` command. Changes to `DEBUG CRASH NOREBOOT`.	00
206C0020	Controller was forced to restart in order for new controller code image to take effect.	00
206D0000	Controller code load was not completed because the controller could not rundown all units.	00
206E0000	A restart of both controllers is required after entering Multiple-bus Failover and the last Failover mode of the source controller was Transparent, or after entering Transparent Failover and the last Failover mode of the source controller was Multipl-bus.	00
43000100	Encountered an unexpected structure type on `HP_WORK_Q`.	01
43030100	Unable to allocate the necessary number of large sense data buckets in `HPP_INIT( )`.	01
43100100	Encountered a NULL completion routine pointer in a DD.	01
43130100	Could not allocate a large sense bucket.	01
43160100	A sense data bucket of unknown type (neither large nor small) was passed to `DEALLOCATE_SDB( )`.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 49 of 55)

Last Failure Code	Description	Repair Action Code
43170100	Call to `VA$ENABLE_NOTIFICATION( )` failed due to insufficient resources.	01
43190100	Unable to allocate necessary memory in `HPP_INIT( )`.	01
431A0100	Unable to allocate necessary timer memory in `HPP_INIT( )`.	01
43210101	HPP detected unknown error indicated by HPT. Last failure parameter [0] contains the error value.	01
43220100	Unable to obtain free CSR in `HPP( )`.	01
43230101	During processing to maintain consistency of the data for persistent reserve SCSI commands, an internal inconsistency was detected. Last failure parameter [0] contains a code defining the precise nature of the inconsistency.	01
44640100	Not enough abort requests in the system.	01
44650100	Exceeded the number of SCSI Exchange State Table (SEST) abort retries.	01
44660100 44670100 44680100 44690100 446A0100 446B0100 446C0100 446D0100 446E0100 446F0100	Unable to allocate enough abort requests for Fibre Channel host port transport software layer. Changes to command HTBs. Changes to FC HTBs. Changes to work requests. Changes to HTBs. Changes to TIS structures. Changes to MFSs. Changes to TACHYON headers. Changes to EDB structures. Changes to LSFS structures.	01
44700100	Unable to allocate enough TPS structures for Fibre Channel host port transport software layer.	01
44720101	An illegal status was returned to the Fabric Login (FLOGI) command error handler: Last failure parameter [0] contains error value.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 50 of 55)

Last Failure Code	Description	Repair Action Code
44730101	An illegal completion message was returned by the TACHYON to the Intel i960 processor: Last failure parameter [0] contains the completion message type.	01
44740101	The host port transport process handler received an illegal timer: Last failure parameter [0] contains the timer pointer type.	01
44750100	The host port transport work handler received an illegal work request.	01
44760100	The host port transport ran out of work requests.	01
44770102	An illegal script return value was received by the host port transport init script handler: Last failure parameter [0] contains the init function. Last failure parameter [1] contains return value. The host port transport ran out of work requests.	01
44780102	An illegal script return value was received by the host port transport send script handler: Last failure parameter [0] contains the send function. Last failure parameter [1] contains return value. The host port transport ran out of work requests.	01
44790102	An illegal script return value was received by the host port transport response script handler: Last failure parameter [0] contains the RSP function. Last failure parameter [1] contains return value. The host port transport ran out of work requests.	01
447A0102	An illegal script return value was received by the host port transport error script handler: Last failure parameter [0] contains the error function. Last failure parameter [1] contains return value. The host port transport ran out of work requests.	01
447B0100	The host port transport response script handler received a response before a command was sent.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 51 of 55)

Last Failure Code	Description	Repair Action Code
447C0101	Unhandled command HTB status: Last failure parameter [0] contains the status value. The host port transport ran out of work requests.	01
447D0100	The host port transport ran out of command HTBs.	01
44800101 44810101	An illegal status was returned to the name service command error handler: Last failure parameter [0] contains error value. Changes to Port Login (PLOGI).	01
44820101	An illegal abort type was given to the host port transport abort handler. Last failure parameter [0] contains abort type.	01
44830101	An illegal failover request was given to the host port transport request handler: Last failure parameter [0] contains failover request.	01
44840101	An illegal failover response was given to the host port transport failover response handler: Last failure parameter [0] contains failover response.	01
44850100	The host port transport failover control had a bad send count.	01
44860100	Unable to allocate enough ESD structures for Fibre Channel host port transport software layer.	01
44870101	An illegal abort type was given to the host port transport abort handler: Last failure parameter [0] contains abort type.	01
44892091	Host port hardware diagnostic field at system initialization: Last failure parameter [0] contains failed port number.	20
448B0100	Host port transport software layer unable to allocate work item for updating NV memory during LOGI.	01
448C0100	Host port transport software layer unable to allocate work item for LOGI completion routine.	01
448E0100	Host port transport software layer unable to allocate memory for quick FC responses.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 52 of 55)

Last Failure Code	Description	Repair Action Code
448F0100	Host port transport software layer unable to allocate memory for quick responses.	01
44900100	Host port transport software layer unable to allocate memory for HCBs.	01
44910100	Host port transport software layer unable to allocate memory for HTB TACHYON header.	01
44920101	An invalid work item was detected on abort pending work queue: Last failure parameter [0] contains invalid work type.	01
44930100	Unable to allocate enough peer-to-peer remote copy TACHYON headers for Fibre Channel host port transport software layer.	01
44940100	Host port transport software layer detected an error during buffer-to-buffer credit check.	01
44950100	Host port transport software layer unable to acquire an FC quick response resource.	01
44960101	An invalid work item was detected on work pending queue: Last failure parameter [0] contains invalid work type.	01
44970100	Host port transport software layer unable to access TACHYON register.	01
449A0101	An invalid work item was detected on abort pending work queue: Last failure parameter [0] contains work type.	01
64000100	Insufficient buffer memory to allocate data structures needed to propagate SCSI mode select changes to the “other controller.”	01
64010100	During an initialization of LUN-specific mode pages, an unexpected device type was encountered.	01
64030104	A DD is already in use by an `RCV_DIAG` command—cannot get `RCV_DIAG` (two) without sending the data for the first: Last failure parameter [0] contains `DD_PTR`. Last failure parameter [1] contains blocking `HTB_PTR`. Last failure parameter [2] contains `HTB_PTR` flags. Last failure parameter [3] contains this `HTB_PTR`.	01
64040100	An attempt to allocate a free VAR failed.	01
80010100	An HTB was not available to issue an I/O when it should have been.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 53 of 55)

Last Failure Code	Description	Repair Action Code
80030100	*DILX* tried to release a facility that was not reserved by *DILX*.	01
80040100	*DILX* tried to change the unit state from Maintenance mode to Normal mode but was rejected because of insufficient resources.	01
80050100	*DILX* tried to change the USB unit state from Maintenance mode to Normal mode, but *DILX* never received notification of a successful state change.	01
80060100	*DILX* tried to switch the unit state from Maintenance mode to Normal mode but was not successful.	01
80070100	*DILX* aborted all commands through `VA$D_ABORT( )`, but the HTBs have not been returned.	01
80090100	*DILX* received an end message that corresponds to an OpCode not supported by *DILX*.	01
800A0100	*DILX* was not able to restart HIS timer.	01
800B0100	*DILX* tried to issue an I/O for an OpCode not supported.	01
800C0100	*DILX* tried to issue a oneshot I/O for an OpCode not supported.	01
800D0100	A *DILX* device control block contains an unsupported `UNIT_STATE`.	01
800F0100	A *DILX* command completed with a sense key that *DILX* does not support.	01
80100100	*DILX* could not compare buffers because no memory was available from `EXEC$ALLOCATE_MEM_ZEROED`.	01
80110100	While *DILX* was de-allocating its deferred error buffers, at least one buffer could not be found.	01
80120100	*DILX* expected an EIP to be on the receive EIP queue, but no EIPs were in the queue.	01
80130100	*DILX* was asked to fill a data buffer with an unsupported data pattern.	01
80140100	*DILX* could not process an unsupported answer in `DX$REUSE_PARAMS( )`.	01
83020100	An unsupported message type or terminal request was received by the *CONFIG* virtual terminal code from the CLI.	01
83030100	Not all `ALTER_DEVICE` requests from the *CONFIG* utility completed within the timeout interval.	01

Table 56: Last Failure Codes and Repair Action Codes (Sheet 54 of 55)

Last Failure Code	Description	Repair Action Code
83050100	An unsupported message type or terminal request was received by the *CFMENU* utility code from the CLI.	01
84010100	An unsupported message type or terminal request was received by the *CLONE* virtual terminal code from the CLI.	01
85010100	*HSUTIL* tried to release a facility that was not reserved by *HSUTIL*.	01
85020100	*HSUTIL* tried to change the unit state from Maintenance to Normal mode but was rejected because of insufficient resources.	01
85030100	*HSUTIL* tried to change the USB unit state from Maintenance to Normal mode, but *HSUTIL* never received notification of a successful state change.	01
85040100	*HSUTIL* tried to switch the unit state from Maintenance to Normal mode but was not successful.	01
86000020	Controller was forced to restart in order for new code load or patch to take effect.	00
86010010	The controller code load function is about to update the program card. This requires controller activity to cease. This code is used to inform the “other controller” that “this controller” has stopped responding to inter-controller communications during card update. An automatic restart of the controller at the end of the program card update causes normal controller activity to resume.	00
86020011	The EMU firmware returned a bad status after directed to prepare for a code load: Last failure parameter [0] contains the value of the bad status.	00

Table 56: Last Failure Codes and Repair Action Codes (Sheet 55 of 55)

Last Failure Code	Description	Repair Action Code
8A040080	New cache module failed diagnostics. The controller was reset to clear the error.	00
8A050080	Could not initialize new cache module. The controller was reset to clear the error.	00
8B000186	An single bit error was found by software scrubbing: Last failure parameter [0] contains the address of the first single bit error correction code (ECC) error found. Last failure parameter [1] contains the count of single bit ECC errors found in the same region below this address. Last failure parameter [2] contains the lower 32 bits of the actual data read at the parameter [0] address. Last failure parameter [3] contains the higher 32 bits of the actual data read at the parameter [0] address. Last failure parameter [4] contains the lower 32 bits of the expected data at the parameter [0] address. Last failure parameter [5] contains the higher 32 bits of the expected data at the parameter [0] address.	01

Alternative Controller Operations

7

This section covers the following topics:

- Handling host-configured units in error, page 270
- Setting SCSI Fairness, page 272

Handling host-configured units in error

Handling host-configured units requires additional maintenance if a unit is in error. Highly functional host OSes, such as Tru64 UNIX using Logical Storage Manager (LSM), provide redundancy for storage volumes. The host systematically maintains a viable path to a unit through internal checks on a periodic basis. In maintaining a viable path to a unit that is in error, the host might not disengage a storage unit and resume error free operations. For example:

- In several instances, while using LSM with Tru64 UNIX, the host does not fail over to the backup controller in a timely manner, after a unit becomes inoperative. These instances usually involve non-redundant storage on HSG80 array controllers that are configured as redundant storage by LSM through the host.
- In other instances, array controllers do not discontinue attempts to perform I/O to the unit. This causes continuous resets on the failed device's bus.

HSG80 array controllers, which are highly redundant, endeavor to successfully complete read and write operations on host requests. If you deploy redundancy by using host-based mirroring capabilities, with non-redundant storage containers across multiple controllers, the controller is unable to determine the higher level of redundancy provided for a specific unit.

If you use LSM with Tru64 UNIX for host-mirroring and mirror units that are non-redundant storage containers, quicker error recovery of the array controller occurs, allowing LSM to transfer the I/O requests to the host mirrored storage units.

In examining unit error handling operations, the following changes have been made to ACS V8.8-1:

- If a device reports a hardware error, the error is reported to the unit if it is related to the host I/O. If a second hardware error is reported by or against the same physical device, the second hardware error is reported to the unit as an `E0_06`, and the:
  - Redundant and normalized set is reduced, and the bad device is ejected to the failed set.
  - Non-redundant containers are transitioned to an Inoperative state. If the host retries a command, a check condition and `SK=2 (not ready)` with ASC/Q of `04_00` is reported. The host might retry the I/O until it suspends its retry attempts.

- Any device in error recovery, where the error recovery against the same device results in two SCSI BUS resets within a 2 minute interval, fails with the following conditions:
  - Normalized and redundant containers are reduced.
  - Normalizing and redundant containers are reduced only if the device that caused the SCSI bus reset is the device that is in the normalizing target.
  - Non-redundant containers transition the unit to an Inoperative state. If the host retries a command, a check condition and SK=2 (not ready) with ASC/Q of 04_00 is reported. The host might retry the I/O until it suspends its retry attempts.

Caution: If a controller fails out one member of a host-redundant unit leaving only one remaining member, it is essential that you do one of the following:

- Promptly repair the failed unit so that it can be placed back into service.
- Issue the SET *<unit> NOHOST_REDUNDANT* CLI command on the operational host-mirrored unit. If the unit failure exists on the subsystem, and there is no redundancy (from the host perspective or LSM level), then, for best availability to data, you must issue the SET *<unit> NOHOST_REDUNDANT* CLI command on the operational unit to cause the unit to enter into Failover mode. Otherwise, the controller (not knowing that the other host-mirrored redundant mirror failed), performs a quick failure to the host, rendering a once redundant volume, inoperative.

Setting SCSI Fairness

Architecturally, the SCSI bus is inherently unfair in the way it drives bus priority. For subsystems with six shelves, the bus priorities (highest to lowest) are set to 5, 4, 3, 2, 1, 0, 15, 14, 13, 12, 11, 10, 9, and 8. For subsystems with three shelves that employ a split shelf configuration, where each shelf has a dual I/O module, the bus priorities are set to 5, 4, 3, 2, 1, 0, and 8. As initiators for the disk device buses, HSG60 and HSG80 array controllers are assigned a priority of 7 and 6. The remaining SCSI IDs are for disk devices located in the shelves.

On extremely busy subsystems, performance on devices at ID 8 through 15 (split shelves, 1, 0, 8) can degrade significantly if the higher IDs are extremely busy. If SCSI disk devices are SCSI-3 devices, they adhere to an HP specification that dictates that they have a *fairness algorithm* that levels the device performance across a single SCSI bus. Under test conditions, where an equal I/O load is applied to all targets on a SCSI bus, in an unfair condition, the top four SCSI target IDs can consume up to 95 percent of the MBs transferred on the SCSI bus. Tests have further noted that if this scenario occurs, latency for I/O completion to the host can exceed 20 seconds.

This `SET` *`controller SCSI_FAIRNESS=ON`* CLI command allows the controller to identify all SCSI-3 disk devices and enable fairness algorithms.

Note: If you have already optimized your storage unit configuration to specific SCSI IDs and buses, you should *not* consider enabling this SCSI fairness with the `SET` *`controller SCSI_FAIRNESS=ON`* command.

Note: HP StorageWorks HSG60 and HSG80 array subsystems were initially designed to support only SCSI-2 devices. Currently, these subsystems support both SCSI-2 and SCSI-3 devices. You should note that HP indiscriminately supplies either SCSI-2 or SCSI-3 compliant devices as new or replacement spares for your subsystem. Issuance of a specific device type is not guaranteed.

Tip: The best scenario for operating devices with optimal performance and SCSI fairness is to use SCSI-3 compliant devices and enable SCSI fairness. If you are unable to follow this guideline, allow your most active devices to comprise SCSI-3 devices in the SCSI ID range of 5, 4, 3, and 2, and operate your heaviest load to the drives at these IDs. Also, avoid placing the I/O load on SCSI-2 devices that are at high priority IDs. To determine the I/O load per device bus, issue the `DISPLAY DEVICES` command from a *VTDPY* prompt.

glossary

This glossary defines terms pertaining to HSG60 and HSG80 array controllers. This glossary is not a comprehensive glossary of computer terms.

8B/10B
A type of byte encoding and decoding to reduce errors in data transmission patented by the IBM Corporation. This process of encoding and decoding data for transmission was adopted by ANSI.

ACS
Array Controller Software. The software component of the HS-series array controller storage systems. ACS executes on the controller and processes input and output (I/O) requests from the host, performing device-level operations required to satisfy the requests.

adapter
A device that converts the protocol and hardware interface of one bus type into that of another without changing functionality of the bus.

AL_PA
Arbitrated loop physical address. A one-byte value used to identify a port in an Arbitrated Loop topology. The AL_PA value corresponds to bits 7:0 of the 24-bit Native Address Indentifier.

alias address
An AL_PA value recognized by an arbitrated loop port in addition to the assigned AL_PA.

ANSI
American National Standards Institute. An organization that develops standards used voluntarily by many manufacturers within the USA. ANSI is not a government agency.

arbitrate
A process of selecting one L_Port from a collection of several ports that request use of the arbitrated loop concurrently.

arbitrated loop
A loop type of topology where two or more ports can be interconnected, but only two ports at a time can communicate.

arbitrated loop physical address
See AL_PA.

array controller
See controller.

array controller software
See ACS.

association set
A group of remote copy sets that share selectable attributes for logging and failover. Members of an association set transition to the same state simultaneously. For example, if one association set member assumes the failsafe locked condition, then other members of the association set also assume the failsafe locked condition.

An association set can also be used to share a log between a group of remote copy set members that require efficient use of the log space.

See also remote copy set.

asynchronous
pertaining to a transmission technique that does not require a common clock between the communicating devices.

See also synchronous.

autospare
A controller feature that automatically replaces a failed disk drive. Autospare aids the controller in automatically replacing failed disk drives. You can enable the `AUTOSPARE` switch for the failedset causing physically replaced disk drives to be automatically placed into the spareset. *Also called* autonewspare.

backplane
The electronic printed circuit board into which subsystem devices are plugged—for example, the SBB or power supply.

bad block
A data block that contains a physical defect.

bad block replacement
See BBR.

battery hysteresis
The ability of the software to allow writeback caching during the time a battery is charging, but only if a previous down time period has not drained more than 50 percent of rated battery capacity.

BBR
Bad block replacement. A replacement routine that substitutes defect-free disk blocks for those found to have defects. This process takes place in the controller, transparent to the host.

BIST
Built-in self-test. A diagnostic test performed by the array controller software on the controller policy processor.

bit
A single binary digit having a value of either 0 or 1. A bit is the smallest unit of data a computer can process.

block
A number of consecutive bytes of data stored on a storage device. In most storage systems, a block is the same size as a physical disk sector. *Also called* sector.

bootstrapping
A method used to bring a system or device into a defined state by means of its own action. For example, a machine routine whose first few instructions are enough to bring the rest of the routine into the computer from an input device.

built-in self-test
See BIST.

byte
A binary character string made up of 8 bits operated on as a unit.

cache memory
A portion of memory used to accelerate read and write operations. The objective of caching data in a system is to improve performance by placing the most frequently used data in the highest performance memory.

cache module
A fast storage buffer.

CCITT
Consultive Committee International Telephone and Telegraph. An international association that sets worldwide communication standards. Renamed International Telecommunications Union (ITU).

CDU
Cable distribution unit. The power entry device for HP StorageWorks racks (cabinets). The CDU provides the connections necessary to distribute power to the rack enclosures and fans.

channel
An interface that allows for the high speed transfer of large amounts of data. Another term for a SCSI bus.

See also SCSI.

chunk
In any form of RAID that stripes data, data is stored in pieces called chunks. One chunk is stored on each member device in the unit. Taken together, the chunks make up a stripe. The chunk size can be used in some controllers to tune the stripeset for a specific application.

chunk size
The number of data blocks, assigned by a system administrator, written to the primary RAIDset or stripeset member before the remaining data blocks are written to the next RAIDset or stripeset member.

CLCP
Code-Load Code-Patch utility. This utility can be used to download patches to the Array Controller Software.

CLI
Command Line Interface. A command line entry application used to interface with the HS-series controllers. CLI enables the configuration and monitoring of a storage subsystem through textual commands.

coax or coaxial cable
A two-conductor wire in which one conductor completely wraps the other with the two separated by insulation.

command line interface
See CLI.

computer interconnect bus
See CI bus.

configuration file
A file that contains a representation of a storage subsystem configuration.

container
(1) Any entity that is capable of storing data, whether it is a physical device or a group of physical devices. (2) A virtual, internal controller structure representing either a single disk or a group of disk drives linked as a storageset. Stripesets and mirrorsets are examples of storageset containers that the controller uses to create units.

See also storage unit.

controller
A hardware device that, with proprietary software, facilitates communications between a host and one or more storage devices organized in a storage array. The HP StorageWorks HS-series family of controllers are all array controllers.

copying
A state in which data to be copied to the mirrorset is inconsistent with other members of the mirrorset.

See also normalizing.

Copying member
Any member that joins the mirrorset after the mirrorset is created is regarded as a Copying member. After all the data from the Normal member (or members) is copied to a Normalizing or Copying Member, the Copying Member then becomes a Normal member.

See also Normalizing member.

CSR
Control and Status Register.

DAEMON
A program usually associated with a UNIX system that performs a utility (housekeeping or maintenance) function without being requested or even known of by the user. A daemon is a diagnostic and execution monitor.

data center cabinet (rack)
A generic reference to large subsystem racks, such as those in which HP StorageWorks products can be mounted.

data striping
The process of segmenting logically sequential data, such as a single file, so that segments can be written to multiple physical devices (usually disk drives) in a round-robin fashion. This technique is useful if the processor is capable of reading or writing data faster than a single disk can supply or accept the data. While data is being transferred from the first disk, the second disk can locate the next segment.

DDL
Dual data link. The ability to operate on the CI bus with both paths simultaneously to the same remote node.

device
In its physical form, a magnetic disk that can be attached to a SCSI bus. The term is also used to indicate a physical device that is made part of a controller configuration; that is, a physical device that is known to the controller. Units (virtual disks) can be created from devices, once the devices have been made known to the controller.

The targets, initiators, hubs, converters, adapters, and similar items are interconnected to form a SCSI bus. Connectors, expanders, and hubs do not use a SCSI bus ID.

See also node and peripheral device.

differential I/O module
A 16-bit I/O module with SCSI bus converter circuitry for extending a differential SCSI bus.

See also I/O module.

differential SCSI bus
A bus in which a signal level is determined by the potential difference between two wires. A differential bus is more robust and less subject to electrical noise than is a single-ended bus.

DILX
Disk Inline Exerciser. The controller diagnostic utility used to test the data transfer capabilities of units in a way that simulates a high level of user activity.

DIMM
Dual inline memory module.

dirty data
The writeback cached data that has not been written to storage media, even though the host operation processing the data has completed.

DMA
Direct memory access.

DOC
DWZZA-on-a-chip. An SYM53C120 SCSI bus extender chip used to connect a SCSI bus in one enclosure to the corresponding SCSI bus in another enclosure.

driver
A hardware device or a program that controls or regulates another device. For example, a device driver is a driver developed for a specific device that allows a computer to operate with devices, such as a printer or a disk drive.

dual-redundant configuration
A controller configuration consisting of two active controllers operating as a single controller. If one controller fails, the other controller assumes control of the failing controller devices.

dual-simplex
A communications protocol that allows simultaneous transmission in both directions in a link, usually with no flow control.

DUART
Dual Universal Asynchronous Receiver and Transmitter. An integrated circuit containing two serial, asynchronous transceiver circuits.

DWZZA
An HP StorageWorks SCSI bus signal converter used to connect 8-bit single-ended devices to hosts with 16-bit differential SCSI adapters. This converter extends the range of a single-ended SCSI cable to the limit of a differential SCSI cable.

See also DOC and SCSI bus signal converter.

DWZZB
An HP StorageWorks SCSI bus signal converter used to connect a variety of 16-bit single-ended devices to hosts with 16-bit differential SCSI adapters.

See also DOC and SCSI bus signal converter.

DWZZC
The 16-bit, SCSI table-top SCSI bus signal converter used to extend a differential SCSI bus, or connect a differential SCSI bus to a single-ended SCSI bus.

See also DOC and SCSI bus signal converter.

ECB
External cache battery. The unit that supplies backup power to the cache module in the event the primary power source fails or is interrupted.

ECC
Error correction code.

EDC
Error detection code.

EIA
Electronic Industries Association. A standards organization specializing in the electrical and functional characteristics of interface equipment.

EMU
Environmental monitoring unit. A unit that provides increased protection against catastrophic failures. Some subsystem enclosures include an EMU that works with the controller to detect conditions such as failed power supplies, failed blowers, elevated temperatures, and external air sense faults. The EMU also controls certain rack hardware including DOC chips, alarms, and fan speeds.

environmental monitoring unit
See EMU.

ESD
Electrostatic discharge. The discharge of potentially harmful static electrical voltage as a result of improper grounding.

extended subsystem
A subsystem in which one or two enclosures are connected to the primary enclosure.

external cache battery
See ECB.

F_Port
A port in a fabric where an N_Port or NL_Port may attach.

fabric
A group of interconnections between ports that includes a fabric element.

failback
The process of restoring data access to the newly-restored controller in a dual-redundant controller configuration.

See also failover.

failedset
A group of disk drives that have been removed from RAIDsets due to a failure or a manual removal. Disk drives in the failedset should be considered defective and should be tested and repaired before being placed back into the spareset.

See also spareset.

failover
The process that takes place after one controller in a dual-redundant configuration assumes the workload of a failed companion controller. Failover continues until the failed controller is repaired or replaced.

See also failback.

fault management utility
See FMU.

FC–AL
The Fibre Channel Arbitrated Loop standard.

FC–ATM
ATM AAL5 over Fibre Channel.

FCC
Federal Communications Commission. The federal agency responsible for establishing standards and approving electronic devices within the United States.

FCC Class A
A certification label that appears on electronic devices that can only be used in a commercial environment within the United States.

FCC Class B
A certification label that appears on electronic devices that can be used in either a home or a commercial environment within the United States.

FC–FG
Fibre Channel Fabric Generic Requirements.

FC–FP
Fibre Channel Framing Protocol (HIPPI on FC).

FC–GS-1
Fibre Channel Generic Services-1.

FC–GS-2
Fibre Channel Generic Services-2.

FC–IG
Fibre Channel Implementation Guide.

FC–LE
Fibre Channel Link Encapsulation (ISO 8802.2).

FCP
The mapping of SCSI-3 operations to Fibre Channel.

FC–PH specification
Short for The Fibre Channel Physical and Signaling Interface Standard.

FC–SB
Fibre Channel Single Byte Command Code Set.

FC–SW
Fibre Channel Switched Topology and Switch Controls.

FD SCSI
A fast, narrow, differential SCSI bus with an 8-bit data transfer rate of 10 MB/s.

See also FWD SCSI and SCSI.

FDDI
Fiber distributed data interface. An ANSI standard for 100 megabaud transmission over fiber optic cable.

fiber
A fiber or optical strand. Spelled fibre in Fibre Channel.

fiber optic cable
A transmission medium designed to transmit digital signals in the form of pulses of light. Fiber optic cables are noted for properties of electrical isolation and resistance to electrostatic contamination.

FL_Port
A port in a fabric where an N_Port or NL_Port may be connected.

flush
The act of writing dirty data from cache to a storage media.

See also dirty data.

FMU
Fault Management Utility. A utility that is run to provide fault or error reporting information.

forced errors
A data bit indicating that a corresponding logical data block contains unrecoverable data.

frame
An invisible unit used to transfer information in Fibre Channel.

FRU
Field replaceable unit. A hardware component that can be replaced at the customer location by HP-authorized service providers.

FRUTIL
Field replacement utility. A utility used to replace field replaceable components, such as controllers, cache modules, PVAs, and ECBs.

full duplex
A communications method in which data can be transmitted and received at the same time.

full duplex
A communications system in which there is a capability for 2-way transmission and acceptance between two sites at the same time.

FWD SCSI
A fast, wide, differential SCSI bus with a maximum 16-bit data transfer rate of 20 MB/s.

See also SCSI and FD SCSI.

GBIC
Gigabyte interface converter.

giga
A prefix indicating a billion (10^9) units.

gigabaud
An encoded bit transmission rate of one billion (10^9) bits per second.

gigabyte
A value normally associated with disk drive storage capacity, meaning a billion (10^9) bytes. The decimal value 1024 is usually used for one thousand.

GLM
Gigabit link module.

half-duplex
A communications system in which data can be either transmitted or received but only in one direction at one time.

hard address
The AL_PA that an NL_Port attempts to acquire during loop initialization.

HBVS
Host-based volume shadowing. Also known as Phase 2 volume shadowing.

HIPPI–FC
Fibre Channel over HIPPI.

host
The primary or controlling computer to which a storage subsystem is attached.

host adapter
A device that connects a host system to a SCSI bus. The host adapter usually performs the lowest layers of the SCSI protocol. This function may be logically and physically integrated into the host system.

host compatibility mode
A setting used by the controller to provide optimal controller performance with specific operating systems. This improves the controller performance and compatibility with the specified operating system.

hot disks
A disk containing multiple hot spots. Hot disks occur after the workload is poorly distributed across storage devices, preventing optimum subsystem performance.

See also hot spots.

hot spots
A portion of a disk drive frequently accessed by the host. Because the data being accessed is concentrated in one area, rather than spread across an array of disks providing parallel access, I/O performance is significantly reduced.

See also hot disks.

hot-pluggable
A replacement method that allows normal I/O activity on a device bus to remain active during device removal and insertion. The device being removed or inserted is the only device that cannot perform operations during this process.

See also pluggable.

HP StorageWorks
A family of modular data storage products that allow customers to design and configure their own storage subsystems. Components include power, packaging, cabling, devices, controllers, and software. Customers can integrate devices and array controllers in HP StorageWorks enclosures to form storage subsystems. HP StorageWorks systems include integrated devices and array controllers to form storage subsystems.

HSUTIL
A format and device code load utility.

I/O
Refers to input and output functions.

I/O driver
The set of code in the kernel that handles the physical I/O to a device. This is implemented as a fork process. Same as driver.

I/O interface
See interface.

I/O module
A device that integrates an enclosure with either an 8-bit single-ended SCSI bus, 16-bit single-ended SCSI bus, 16-bit differential SCSI bus, or Fibre Channel bus.

I/O operation
The process of requesting a transfer of data from a peripheral device to memory (or vice versa), the actual transfer of the data, and the processing and overlaying activity to make both of those happen.

IBR
Initial boot record.

ILF
Illegal function.

INIT
Initialize.

initiator
A SCSI device that requests an I/O process to be performed by another SCSI device, namely, the SCSI target. The controller is the initiator on the device bus. The host is the initiator on the host bus.

Instance Code
A four-byte value displayed in most text error messages and issued by the controller after a subsystem error occurs. The Instance Code indicates, during software processing, that the error was detected.

interface
A set of protocols used between components, such as cables, connectors, and signal levels.

IPI
Intelligent peripheral interface. An ANSI standard for controlling peripheral devices by a host computer.

IPI-3 Disk
Intelligent peripheral interface level 3 for disk.

IPI-3 Tape
Intelligent peripheral interface level 3 for tape.

JBOD
Just a bunch of disks. A term used to describe a group of single-device logical units not configured into any other container type.

kernel
The most privileged processor access mode.

L_port
A node or fabric port capable of performing arbitrated loop functions and protocols. NL_ports and FL_ports are loop-capable ports.

LBN
Logical Block Number. A volume-relative address of a block on a mass storage device. The blocks that form the volume are labeled sequentially starting with LBN 0.

LED
Light-emitting diode.

link
A physical connection between two Fibre Channel ports.

local connection
A connection to the subsystem, by way of the controller serial maintenance port, to a maintenance terminal or the host terminal. A local connection enables you to connect to one subsystem controller to perform maintenance tasks.

See also maintenance terminal and local terminal.

local terminal
A terminal plugged into the EIA-423 maintenance port located on the front bezel of the controller.

See also maintenance terminal and local connection.

logical block number
See LBN.

logical bus
A single-ended bus connected to a differential bus by a SCSI bus signal converter.

logical unit
A physical or virtual device addressable through a target ID number. Logical units use their target bus connection to communicate on the SCSI bus.

See also unit.

logical unit number
See LUN.

logon
Also called login. A procedure whereby a participant, either a person or network connection, is identified as being an authorized network participant.

loop
See arbitrated loop.

loop tenancy
The period of time that occurs when a port *wins* loop arbitration and after the port returns to a monitoring state.

loop_ID
A seven-bit value numbered contiguously from zero to 126-decimal, representing the 127 legal AL_PA values on a loop. Not all of the 256 hex values are allowed as AL_PA values per FC-AL.

LRU
Least recently used. A cache term used to describe the block replacement policy for read cache.

LUN
Logical Unit Number. A value that identifies a specific logical unit belonging to a SCSI target ID number. A number associated with a physical device unit during task I/O operations. Each task in the system must establish its own correspondence between logical unit numbers and physical devices.

See also logical unit.

maintenance terminal
An EIA-423-compatible terminal used with the controller. This terminal is used to identify the controller, enable host paths, enter configuration information, and check controller status. The maintenance terminal is not required for normal operations.

See also local terminal and local connection.

mass storage control protocol
See MSCP.

Mbps
Approximately one million (10^6) bits per second—that is, megabits per second.

MBps
Approximately one million (10^6) bytes per second—that is, megabytes per second.

member
A container that is a storage element in a RAID array.

metadata
The data written to a disk for the purposes of controller administration. Metadata improves error detection and media defect management for the disk drive. Metadata is also used to support storageset configuration and partitioning. Nontransportable disks also contain metadata to indicate they are uniquely configured for HP StorageWorks environments. Metadata can be thought of as *data about data*.

mirrored writeback caching
A method of caching data that maintains two copies of the cached data. The copy is available if either cache module fails.

mirroring
The act of creating an exact copy or image of data.

mirrorset
See RAID level 1.

MIST
Module Integrity Self-Test.

MSCP
Mass storage control protocol. The protocol by which blocks of information are transferred between the host and the controller over the CI bus.

Multiple-bus Failover
A controller operational mode that allows the host to control the failover process by moving the unit(s) from one controller to another.

N_Port
A port attached to a node for use with point-to-point topology or fabric topology.

network
In data communication, a configuration in which two or more terminals or devices are connected to enable information transfer.

NL_Port
A port attached to a node for use in all three topologies.

node
In data communications, the point at which one or more functional units connect transmission lines. In Fibre Channel, a device that has at least one N_port or NL_port.

nominal membership
The desired number of mirrorset members after the mirrorset is fully populated with active devices. If a member is removed from a mirrorset, the actual number of members may fall below the *nominal* membership.

Non-L_Port
A node-of-fabric port that is not capable of performing the Arbitrated Loop functions and protocols. N_ports and F_ports are loop-capable ports.

non-participating mode
A mode within an L_port that inhibits the port from participating in loop activities. L_ports in this mode continue to retransmit received transmission words but are not permitted to arbitrate or originate frames. An L_port in non-participating mode may or may not have an AL_PA.

See also participating mode.

nonredundant controller configuration
A controller configuration that does not include a second controller.

nonvolatile memory
See NVM.

Normal member
A mirrorset member that, block-for-block, contains the same data as other Normal members within the mirrorset. Read requests from the host are always satisfied by Normal members.

normalizing
A state in which, block-for-block, data written by the host to a mirrorset member is consistent with the data on other normal and Normalizing members. The Normalizing state exists only after a mirrorset is initialized. Therefore, no customer data is on the mirrorset.

Normalizing member
A mirrorset member whose contents are the same as all other Normal and Normalizing members, for data that was written since the mirrorset was created or lost cache data was cleared. A Normalizing member is created by a Normal member after either all of the Normal members fail or all of the Normal members are removed from the mirrorset.

See also Copying member.

NVM
Nonvolatile memory. A type of memory where the contents survive power loss. *Also called* NVMEM. The NVMEM in the controller stores the configuration parameters for the storage subsystem.

OCP
Operator control panel. The control and indicator panel associated with an array controller. The OCP is mounted on the controller and is accessible to the operator

offset
A relative address referenced from the base element address. Event Sense Data Response Templates use offsets to identify various information contained within one byte of memory (bits 0 through 7).

operator control panel
See OCP.

other controller
The controller in a dual-redundant pair that is connected to the controller serving a current CLI session.

See also this controller.

outbound fiber
One fiber in a link that carries information away from a port.

parallel data transmission
A data communication technique in which more than one code element (for example, a bit) of each byte is sent or received simultaneously.

parity
A method of checking if binary numbers or characters are correct by counting the ONE bits. In odd parity, the total number of ONE bits must be odd; in even parity, the total number of ONE bits must be even. Parity information can be used to correct corrupted data. RAIDsets use parity to improve the availability of data.

parity bit
A binary digit added to a group of bits that checks to see if errors exist in the transmission.

parity check
A method of detecting errors after data is sent over a communications line. With even parity, the number of ONEs in a set of binary data should be even. With odd parity, the number of ONEs should be odd.

parity RAID
See RAIDset.

participating mode
A mode within an L_port that allows the port to participate in loop activities. A port must have a valid AL_PA to be in Participating mode.

partition
A logical division of a container, represented to the host as a logical unit.

PCM
Polycenter Console Manager.

PCMCIA
Personal Computer Memory Card Industry Association. An international association formed to promote a common standard for PC card-based peripherals to be plugged into computers. The card, commonly known as a PCMCIA card or program card, is about the size of a credit card.

See also program card.

peripheral device
Any unit, distinct from the CPU and physical memory, that can provide the system with input or accept any output from the unit. Terminals, printers, tape drives, and disks are peripheral devices.

pluggable
A replacement method that allows the complete system to remain online during device removal or insertion. The system bus must be halted, or quiesced, for a brief period of time during the replacement procedure.

See also hot-pluggable.

point-to-point connection
A network configuration in which a connection is established between two, and only two, terminal installations. The connection may include switching facilities.

port
In general terms, the port is:

- A logical channel in a communications system.
- The hardware and software used to connect a host controller to a communications bus, such as a SCSI bus or serial bus.

Regarding the controller, the port is:

- The logical route for data in and out of a controller that can contain one or more channels, all of which contain the same type of data.
- The hardware and software that connects a controller to a SCSI device.

port_name
A 64-bit unique identifier assigned to each Fibre Channel port. The Port_Name is communicated during the logon and port discovery process.

preferred address
The AL_PA that an NL_port attempts to acquire first during initialization.

primary enclosure
The primary enclosure is the subsystem enclosure that contains the controllers, cache modules, external cache batteries, and the PVA module.

private NL_Port
An NL_port that does not attempt login with the fabric and only communicates with NL_ports on the same loop.

program card
The PCMCIA card containing the controller operating software.

See also PCMCIA card.

protocol
The conventions or rules for the format and timing of messages sent and received.

PTL
Port-target-LUN. The controller method of locating a device on the controller device bus.

public NL_Port
An NL_port that attempts login with the fabric and can observe the rules of either public or private loop behavior. A public NL_port may communicate with both private and public NL_ports.

PVA module
Power verification and addressing module.

quiesce
The act of rendering bus activity inactive or dormant. For example, quiescing the SCSI bus operations during a device warm swap.

RAID
Redundant array of independent disks. Represents multiple levels of storage access developed to improve performance or availability or both.

RAID level 0
A RAID storageset that stripes data across an array of disk drives. A single logical disk spans multiple physical disks, allowing parallel data processing for increased I/O performance. While the performance characteristics of RAID level 0 is excellent, this RAID level is the only one that does not provide redundancy. RAID level 0 storagesets are sometimes referred to as stripesets.

RAID level 0+1
A RAID storageset that stripes data across an array of disks (RAID level 0) and mirrors the striped data (RAID level 1) to provide high I/O performance and high availability. RAID level 0+1 storagesets are sometimes referred to as striped mirrorsets.

RAID level 1
A RAID storageset of two or more physical disks that maintains a complete and independent copy of all virtual disk data. This type of storageset has the advantage of being highly reliable and extremely tolerant of device failure. RAID level 1 storagesets are sometimes referred to as mirrorsets.

RAID level 3
A RAID storageset that transfers data parallel across the array disk drives a byte at a time, causing individual blocks of data to be spread over several disks serving as one enormous virtual disk. A separate redundant check disk for the entire array stores parity on a dedicated disk drive within the storageset.

See also RAID level 5.

RAID level 5
A RAID storageset that, unlike RAID level 3, stores the parity information across all of the disk drives within the storageset.

See also RAID level 3.

RAIDset

A specially developed RAID storageset that stripes data and parity across three or more members in a disk array. A RAIDset combines the best characteristics of RAID level 3 and RAID level 5. A RAIDset is the best choice for most applications with small to medium I/O requests, unless the application is write intensive. RAIDsets are sometimes referred to as parity RAIDs or RAID level 3/5 storagesets.

RAM

Random access memory.

read caching

A cache management method used to decrease the subsystem response time to a read request by allowing the controller to satisfy the request from the cache memory rather than from the disk drives.

read-ahead caching

A caching technique for improving performance of synchronous sequential reads by prefetching data from disk.

reconstruction

The process of regenerating the contents of failed member data. The reconstruct process writes the data to a spareset disk and then incorporates the spareset disk into the mirrorset, striped mirrorset, or RAIDset from which the failed member came.

See also regeneration.

reduced

Indicates that a mirrorset or RAIDset is missing one member because the member failed or was physically removed.

redundancy

The provision of multiple interchangeable components to perform a single function in order to cope with failures and errors. A RAIDset is considered to be redundant if user data is recorded directly to one member and all of the other members include associated parity information.

regeneration

1) The process of calculating missing data from redundant data. (2) The process of recreating a portion of the data from a failing or failed drive by using the data and parity information from the other members within the storageset.
The regeneration of an entire RAIDset member is called *reconstruction*.

See also reconstruction.

remote copy
A feature intended for disaster tolerance and replication of data from one storage subsystem or physical site to another subsystem or site. Remote copy also provides methods of performing a backup at either the local or remote site. With remote copy, user applications continue to run while data movement goes on in the background. Data warehousing, continuous computing, and enterprise applications all require remote copy capabilities.

remote copy set
A bound set of two units; one located locally and one located remotely, for long distance mirroring. The units can be a single disk, or a storageset, mirrorset, or RAIDset. A unit on the local controller is designated as the *initiator*, and a corresponding unit on the remote controller is designated as the *target*.

See also association set.

replacement policy
The policy specified by a switch with the `SET FAILEDSET` command indicating whether a failed disk from a mirrorset or RAIDset is to be automatically replaced with a disk from the spareset. The two switch choices are `AUTOSPARE` and `NOAUTOSPARE`.

request rate
The rate at which requests arrive at a servicing entity.

RFI
Radio frequency interference. The disturbance of a signal by an unwanted radio signal or frequency.

SCSI
Small Computer System Interface. (1) An American National Standards Institute (ANSI) interface standard defining the physical and electrical parameters of a parallel I/O bus used to connect initiators to devices. (2) A processor-independent standard protocol for system-level interfacing between a computer and intelligent devices including hard drives, floppy disks, CD-ROMs, printers, scanners, and others.

SCSI bus signal converter
(1) A device used to interface between the subsystem and a peripheral device unable to be mounted directly into the SBB shelf of the subsystem. (2) A device used to connect a differential SCSI bus to a single-ended SCSI bus. (3) A device used to extend the length of a differential or single-ended SCSI bus.

See also DOC, DWZZA, DWZZB, DWZZC, and I/O module. Also called adapter, see adapter.

SCSI device
(1) A host computer adapter, a peripheral controller, or an intelligent peripheral that can be attached to the SCSI bus. (2) Any physical unit that can communicate on a SCSI bus.

SCSI device ID number
A bit-significant representation of the SCSI address referring to one of the signal lines, numbered 0 through 7 for an 8-bit bus, or 0 through 15 for a 16-bit bus.

See also target ID number.

SCSI ID number
The representation of the SCSI address that refers to one of the signal lines numbered 0 through 15.

SCSI port
(1) Software: The channel controlling communications to and from a specific SCSI bus in the system. (2) Hardware: The name of the logical socket at the back of the system unit to which a SCSI device is connected.

SCSI-A cable
A 50-conductor (25 twisted-pair) cable generally used for single-ended, SCSI-bus connections.

SCSI-P cable
A 68-conductor (34 twisted-pair) cable generally used for differential bus connections.

Selective Storage Presentation
Selective Storage presentation is a feature of the HSG80 controller that enables the user to control the allocation of storage space and shared access to storage across multiple hosts. This is also known as *restricting host access*.

serial transmission
A method of transmission in which each bit of information is sent sequentially on a single channel rather than simultaneously as in parallel transmission.

service rate
The rate at which an entity is able to service requests. For example, the rate at which an Arbitrated Loop is able to service arbitrated requests.

signal converter
See SCSI bus signal converter.

SIMM
Single inline memory module.

single ended I/O module
A 16-bit I/O module.

See also I/O module.

single-ended

SCSI bus
An electrical connection where one wire carries the signal and another wire or shield is connected to electrical ground. Each signal logic level is determined by the voltage of a single wire in relation to ground. This is in contrast to a differential connection where the second wire carries an inverted signal.

spareset
A collection of disk drives made ready by the controller to replace failed members of a storageset.

star coupler
The physical hub of the CI cluster subsystem cabling. The star coupler is a set of connection panels, contained within a cabinet containing cable connections and transformers through which the nodes of a cluster connect to one another through the CI bus.

See also nodes and CI bus.

storage array
An integrated set of storage devices

storage array subsystem
See storage subsystem.

storage subsystem
The controllers, storage devices, enclosures, cables, and power supplies used to form a mass storage subsystem.

storage unit
The general term that refers to storagesets, single-disk units, and all other storage devices that are installed in your subsystem and accessed by the host. A storage unit can be any entity that is capable of storing data, whether it is a physical device or a group of physical devices.

See also container.

storageset
(1) A group of devices configured with RAID techniques to operate as a single container.
(2) Any collection of containers, such as stripesets, mirrorsets, striped mirrorsets, and RAIDsets.

storageset expansion
The dynamic expansion of the storage capacity (size) of a unit. A storage container is created in the form of a concatenation set which is added to the existing storage set defined as a unit.

stripe
The data divided into blocks and written across two or more member disks in an array.

stripe size
The stripe capacity as determined by *n*–1 times the chunksize, where *n* is the number of RAIDset members.

striped mirrorset
See RAID level 0+1.

stripeset
See RAID level 0.

striping
The technique used to divide data into segments, also called chunks. The segments are striped, or distributed, across members of the stripeset. This technique helps to distribute hot spots across the array of physical devices to prevent hot spots and hot disks.
Each stripeset member receives an equal share of the I/O request load, improving performance.

surviving controller
The controller in a dual-redundant configuration pair that serves companion devices after the companion controller fails.

switch
A method that controls the flow of functions and operations in software.

synchronous
A method of data transmission which allows each event to operate in relation to a timing signal.

See also asynchronous.

tape
A storage device supporting sequential access to variable sized data records.

target
(1) A SCSI device that performs an operation requested by an initiator. (2) Designates the target identification (ID) number of the device.

target ID number
The address a bus initiator uses to connect with a bus target. Each bus target is assigned a unique target address.

this controller
The controller that is serving your current CLI session through a local or remote terminal.

See also other controller.

TILX
Tape inline exerciser. The controller diagnostic software to test the data transfer capabilities of tape drives in a way that simulates a high level of user activity.

TMSCP
Tape mass storage control protocol. The protocol by which blocks of information are transferred between the host and a CI controller on the CI Bus with tape devices.

topology
An interconnection scheme that allows multiple Fibre Channel ports to communicate with each other. For example, point-to-point, Arbitrated Loop, and switched fabric are all Fibre Channel topologies.

transfer data rate
The speed at which data may be exchanged with the central processor, expressed in thousands of bytes per second.

Transparent Failover
A controller operational mode that allows the storage array remain available to the host by allowing the surviving controller of a dual redundant pair to take over total control of the subsystem and is transparent (invisible) to the host(s).

ULP
Upper Layer Protocol.

ULP process
A function executing within a Fibre Channel node which conforms to the ULP requirements while interacting with other ULP processes.

ultra SCSI bus
A wide, fast-20 SCSI bus.

uninterruptible power supply
See UPS.

unit
A container made accessible to a host. A unit may be created from a single disk drive. A unit may also be created from a more complex container such as a RAIDset. The controller supports a maximum of eight units on each target.

See also target and target ID number.

unwritten cached data
Sometimes called unflushed data.

See also dirty data.

UPS
Uninterruptible power supply. A battery-powered power supply guaranteed to provide power to an electrical device in the event of an unexpected interruption to the primary power supply. Uninterruptible power supplies are usually rated by the amount of voltage supplied and the length of time the voltage is supplied.

VHDCI
Very High-Density-Cable Interface. A 68-pin interface that is required for Ultra SCSI connections.

virtual terminal
A software path from an operator terminal on the host to the controller CLI, sometimes called a host console. The path can be established through the host port on the controller or through the maintenance port through an intermediary host.

See also maintenance terminal.

VTDPY
Virtual Terminal Display. A utility that allows viewing of specific informational displays by using CLI commands.

Worldwide name
A unique 64-bit number assigned to a subsystem by the Institute of Electrical and Electronics Engineers (IEEE) and set by manufacturing prior to shipping. *Also called* node ID within the CLI.

write hole
The period of time in a RAID 1 or RAID 5 write operation at which an opportunity emerges for undetectable RAIDset data corruption. Write holes occur under conditions such as power outages, where the writing of multiple members can be abruptly interrupted. A battery backed-up cache design eliminates the write hole because data is preserved in cache and unsuccessful write operations can be retried.

writeback cache
See cache module.

writeback caching
A cache management method used to decrease the subsystem response time to write requests by allowing the controller to declare the write operation complete as soon as the data reaches the controller cache memory. The controller performs the slower operation of writing the data to the disk drives at a later time.

write-through cache
A cache management technique for retaining host write requests in read cache. After the host requests a write operation, the controller writes data directly to the storage device. This technique allows the controller to complete some read requests from the cache, greatly improving the response time to retrieve data. The operation is complete only after the data to be written is received by the target storage device.

This cache management method may update, invalidate, or delete data from the cache memory accordingly, to ensure that the cache contains the most current data.

write-through caching
A cache management method used to decrease the subsystem response time to a read. This method allows the controller to satisfy the request from the cache memory rather than from the disk drives.

index

A

ASC and ASCQ codes 70
  descriptions table 162
audience 12
authorized reseller, HP 18

B

backup power
  UPS 43
backup power source, enabling writeback caching 46
battery
  checking 43
  hysteresis 42

C

cache module
  cache policies resulting from failures 47
  read caching 44
  replacing cache modules with FRUTIL 132
  writeback caching 45
  write-through caching 45
cache policies. See caching techniques.
caching techniques 44
  cache policies, cache module status (table) 47
  cache policies, ECB status (table) 50
  fault-tolerance for writeback caching 47
  general description 44
  read caching 44
  read-ahead caching 44
  writeback caching 45
  write-through caching 45
change volume serial number utility. See CHVSN utility.
charging diagnostics
  battery hysteresis 42
  general description 42
CHVSN utility general description 133
CLCP utility general description 129
CLI event reporting, controller operation continues 41
CLONE utility general description 131
clone utility. See CLONE utility.
code load code patch utility. See CLCP utility.
code structure
  Instance Code format 178
  last failure code format 212
codes
  ASC and ASCQ descriptions 162
  component identifier (ID) code table 175
  event codes translation 70
  event threshold codes 179
  last failure codes 214 to 268
  recommended repair action codes (table) 167 to 174
  structure of events and instances 178
  translating event codes 70
  types
    asc_ascq_code 70
    component_code 70
    controller_unique_asc_ascq_code 70
    device_type_code 70
    event_threshold_code 70

instance_code 70
last_failure_code 70
repair_action_code 70
restart_type 70
SCSI_command_operation_code 70
sense_data_qualifiers 70
sense_key_code 70
template_codes 70
common data fields definitions, using VTDPY
cache screen 104
default screen 104
status screen 104
component event codes 70
component ID codes 175
relating to instance codes 180
relating to last failure codes 214
table 175
component identifier codes. See component ID codes.
CONFIG utility general description 128
configuration utility. See CONFIG utility.
configuring a dual-redundant controller with mirrored cache 53
controller
checking communication with host 92
checking the battery 43
checking transfer rate with host 92
dual-redundant controller configurations with mirrored cache 53
ECB diagnostics 42
Flashing OCP pattern displays and repair actions (table) 32
halted operation events
Flashing OCP LEDs 32
last failure reporting 39
reporting 31
solid OCP LEDs display 34
patching controller software with the CLCP utility 129
restart codes (table) 213
self-test 41
solid OCP pattern displays and repair actions (table) 35
controller and processor utilization, using VTDPY
default screen 115
status screen 115
conventions
document 15
equipment symbols 16
text symbols 15

D

DAEMON tests 41
data duplicating with the CLONE utility 131
data field definitions
common data fields
part 1 (table) 104
part 2 (table) 105
common fields 104
controller and processor utilization data fields (table) 115
device performance data fields (table) 108
device port data fields (table) 115
device port performance data fields (table) 109
resource performance statistics data fields (table) 117
screen header 103
unit performance data fields 105
VTDPY threads (table) 116
data patterns, DILX write test (table) 121
describing event codes 70
device performance data fields definitions, VTDPY device screen 108
device port configuration, using VTDPY
device screen 114
status screen 114
device port performance data fields definitions, VTDPY device screen 109
device_type codes 70

devices
adding with the CONFIG utility 128
disk
testing read and write capability 121
testing read capability 119
exercising disks 119
finding disks 119
generating a new volume serial number with the CHVSN utility 133
renaming the volume serial number with the CHVSN utility 133
diagnostics, ECB charging 42
DILX 119 to 124
data patterns for phase 1, write test (table) 121
error codes 124
error codes (table) 124
DILX control sequences (commands table) 120
disk drives. See also devices.
adding with the CONFIG utility 128
generating a new volume serial number with the CHVSN utility 133
renaming the volume serial number with the CHVSN utility 133
disk inline exerciser. See DILX.
displaying
current FMU settings 74
event codes 70
last failure codes 68
memory system failures 68
document
conventions 15
prerequisites 12
related documentation 12
dual-redundant controller configurations, configuring for mirrored cache 53

E

ECB
battery hysteresis 42
diagnostics 42
replacing ECBs with FRUTIL 132
enabling mirrored writeback cache 53
equipment symbols 16
error codes, DILX 124
error number field, last failure code 214
event codes
structure and format 178
translating 70
types (table) 70
event NR threshold classifications (table) 179
event number field, Instance Code 180
event reporting
controller operation continues 40
controller operation halted 31
event threshold codes 70
events
controller operation continues
CLI event reporting 41
spontaneous Event log 40
controller operation halted
Flashing OCP LEDs display 32
last failure reporting 39
solid OCP LEDs display 34
exercisers, DILX 119 to 124
exercising disk drives and units 119

F

fault management utility. See FMU.
fault remedy (table) 22
fault-tolerance for writeback caching
general description 45
nonvolatile memory 46
field replacement utility. See FRUTIL.
finding devices 119
flashing OCP LED events, controller operation halted 32
FMU
displaying current display settings 74
enabling
event logging 72
repair action logging 72
timestamp 73
verbose logging 72

general description 68
interpreting
last failures 68
memory system failures 68
logging last failure codes 72
SET commands (table) 72
setting display for 71
translating event codes 70
format and device code load utility. See HSUTIL.
formats
Instance Code (table) 179
last failure code (table) 213
passthrough device reset event sense data response (table) 137
template 01—last failure event sense data response (table) 138
template 04—multiple-bus failover event sense data response (table) 140
template 05—failover event sense data response (table) 142
template 11—nonvolatile parameter memory component event sense data response (table) 145
template 12—backup battery failure event sense data response (table) 147
template 13—subsystem built-in self-test failure event sense data response (table) 149
template 14—memory system failure event sense data response (table) 151
template 41—device services non-transfer error event sense data response (table) 153
template 51—disk transfer error event sense data response (table) 155
template 90—data replication manager services event sense data response (table) 157
formats and structure
Instance Code
illustrated 178
last failure code
illustrated 212
FRUTIL general description 132

G

general descriptions
CHVSN utility 133
CLCP utility 129
CLONE utility 131
CONFIG utility 128
FMU utility 68
FRUTIL utility 132
HSUTIL utility 126
VTDPY utility 89
getting help 18

H

H/W flag field, last failure code 214
hardware/software flag. See H/W flag field.
help, obtaining 18
host port
checking status 92
configuration, using VTDPY
host screen 110
status screen 110
host, checking transfer rate to controller 92
HP
authorized reseller 18
storage website 18
technical support 18
HSUTIL
general description 126
messages and inquiries (table) 126
hysteresis. See battery hysteresis.

I

I/O, checking to host 92
illustrated
sample of the VTDPY remote screen 102
sample of the VTDPY resource screen 101
illustrations
sample of regions on the VTDPY device screen 97

sample of the VTDPY cache screen 95
sample of the VTDPY default screen 93
sample of the VTDPY status screen 94
sample of the VTPDY host screen 99
sample of transfer (Xfer) rate region of the VTDPY default display 91
structure of a last failure code 212
structure of an instance code 178
Instance Code
component ID code field 180
event number field 180
structure and format 178
instance code 177 to 210
displayed using the FMU 179
event NR threshold classifications (table) 179
NR threshold field 179
repair action code field 180
structure (illustrated) 178
structure and format 178
translating 70
using FMU to display codes 68
Instance Codes
format (table) 179
interpreting event codes 178
interpreting screen information, VTDPY screens 102

L

last failure
reporting, controller operation halted events 39
last failure code 211 to 268
component ID code field 214
displayed using the FMU 213
displaying 68
error number field 214
H/W flag field 214
logging 72
parameter count field 213
repair action code field 214
repair action codes correlation (table) 214 to 268
restart code field 213
structure and format 212
structure and format (illustrated) 212
translating 70
using FMU to display codes 68
last failure codes
format (table) 213
list of utilities and exercisers 67
locating devices 119
logging, SET commands
enabling in FMU 72
enabling verbose logging 72
timestamping 73

M

memory system
failures 68
mirrored writeback cache enabling 53
mirrorsets, duplicating data with the CLONE utility 131

N

nonvolatile
memory, fault-tolerance for writeback caching 46
notification and recovery threshold field. See NR threshold field.
NR threshold field, instance code 179

P

parameter count, last failure code 213
passthrough device reset event sense data response format (table) 137
performance statistics
resource 117
power source, enabling writeback caching 46
prerequisites 12
problem solving 20
processor and controller utilization. See controller and processor utilization.

R

rack stability, warning 17
rate of transfer, checking to host 92
read caching
  enabled for all storage units 44
  general description 44
read capability
  disk testing 119
read requests. See also write requests.
  anticipating subsequent read requests with read-ahead caching 44
  decreasing the subsystem response time with read caching 44
read-ahead
  caching 44
  caching enabled for all disk units 44
related documentation 12
remedies for a problem 22
repair action
  Flashing OCP pattern displays (table) 32
  instance code 180
  last failure code 214
  solid OCP pattern displays (table) 35
repair action codes
  (table) 167 to 174
  codes (table) 167 to 174
  last failure codes correlation (table) 214 to 268
  logging 72
  translating 70
resource performance statistics 117
resource performance statistics, using VTDPY resource screen 117
restart code, last failure code 213
restart_type codes 70
running
  controller self-test 41
  DAEMON tests 41
  FMU 68
  VTDPY 89
running DILX 119

S

screen header, VTDPY screens 103
screens, VTDPY
  cache performance screen 95
  controller status screen 93
  default screen 92
  device performance screen 96
  host port host screen 98
  remote status screen 102
  resource statistics screen 100
SCSI command operations 70
self-test 41
setting display characteristics for FMU 71
significant event reporting 31
solid OCP LEDs events, controller operation halted 34
spontaneous Event log, controller operation continues 40
status, host port 92
storagesets
  adding devices with the CONFIG utility 128
  duplicating data with the CLONE utility 131
  generating a new volume serial number with the CHVSN utility 133
  renaming the volume serial number with the CHVSN utility 133
structure of event codes 178
symbols in text 15
symbols on equipment 16
symptoms of a problem 22

T

tables
  ASC and ASCQ code descriptions 162
  cache policies, cache module status 47
  cache policies, ECB status 50
  component identifier (ID) codes 175
  controller restart codes 213

DILX
- control sequences (commands) 120
- data patterns for phase 1, write test 121
- error codes 124

event code types 70
fault remedy 22
Flashing OCP pattern displays and repair actions 32
FMU SET commands 72
HSUTIL messages and inquiries 126
Instance Codes
- format 179

instance codes
- event NR threshold classifications 179

last failure code format 213
last failure codes
- repair action codes correlation 214 to 268

passthrough device reset event sense data response format 137
recommended repair action codes 167 to 174
Related documentation 12
solid OCP pattern displays and repair actions 35
status field first digit on the TACHYON chip 112
status field second digit on the TACHYON chip 112
template 01—last failure event sense data response format 138
template 04—multiple-bus failover event sense data response format 140
template 05—failover event sense data response format 142
template 11—nonvolatile parameter memory component event sense data response format 145
template 12—backup battery failure event sense data response format 147
template 13—subsystem built-in self-test failure event sense data response format 149
template 14—memory system failure event sense data response format 151
template 41—device services non-transfer error event sense data response format 153
template 51—disk transfer error event sense data response format 155
template 90—data replication manager services error event sense data response format 157
VTDPY
- common data fields column definitions
  - part 1 104
  - part 2 105
- device screen
  - controller and processor utilization definitions 115
  - device map column definitions 115
  - device performance data fields column definitions 108
  - device port performance data fields column definitions 109
- Fibre Channel host status screen
  - known host connections 110
  - link error counters 111
  - port status 110
- key sequences and commands 90
- remote screen column definitions 113
- resource screen, resource performance statistics definitions 117
- status screen, controller and processor utilization definitions 115
- thread descriptions 116
- unit performance data fields column definitions 106

TACHYON chip, status field first digit (table) 112
TACHYON chip, status field second digit (table) 112
technical support, HP 18

templates
- 01—last failure event sense data response format (table) 138
- 04—multiple-bus failover event sense data response format (table) 140
- 05—failover event sense data response format (table) 142
- 11—nonvolatile parameter memory component event sense data response format (table) 145
- 12—backup battery failure event sense data response format (table) 147
- 13—subsystem built-in self-test failure event sense data response format (table) 149
- 14—memory system failure event sense data response format (table) 151
- 41—device services non-transfer error event sense data response format (table) 153
- 51—disk transfer error event sense data response format (table) 155
- 90—data replication manager services error event sense data response format (table) 157

testing read capability
- disk 119

text symbols 15
timestamp for logging 73
transfer rate, checking to host 92
translating event codes 70
troubleshooting 22
- checklist 20
- CLCP utility 129
- Flashing OCP pattern displays and repair actions (table) 32
- generating a new volume serial number with the CHVSN utility 133
- guide 12
- patching controller software with the CLCP utility 129
- remedies for a problem 22
- renaming the volume serial number with the CHVSN utility 133
- replacing
  - cache modules with FRUTIL 132
  - controllers with FRUTIL 132
  - ECBs with FRUTIL 132
- See also CONFIG utility and HSUTIL utility.
- solid OCP pattern displays and repair actions (table) 35
- table 22

U

unit performance data fields definitions, using VTDPY
- cache screen 105
- default screen 105
- status screen 105

units
- exercising disks 119

unpartitioned mirrorsets, duplicating data with the CLONE utility 131
upgrading
- EMU software with the CLCP utility 129

UPS
- backup power 43

utilities
- CLCP utility 129

utilities and exercisers
- CHVSN utility 133
- CLCP utility 129
- CLONE utility 130, 131
- CONFIG utility 128
- DILX 119 to 124
- FMU 68 to 74
- FRUTIL 132
- HSUTIL 126
- VTDPY utility 89 to 118

utilities and exercisers, list 67

V

verbose logging 72
video terminal display. See VTDPY.
volume serial number
  generating a new one with the CHVSN utility 133
  renaming with the CHVSN utility 133
VTDPY
  cache screen
    common data fields definitions
      part 1 (table) 104
      part 2 (table) 105
    sample (illustrated) 95
    unit performance data fields definitions (table) 106
  checking communication with host 92
  commands (table) 90
  common data fields 104
  controller and processor utilization configuration 115
  default display, sample of transfer (Xfer) rate region (illustrated) 91
  default screen
    common data fields definitions
      part 1 (table) 104
      part 2 (table) 105
    sample (illustrated) 93
    unit performance data fields definitions (table) 106
  device performance data fields 108
  device port configuration 114
  device port performance data fields 109
  device screen
    controller and processor utilization definitions (table) 115
    device map column definitions (table) 115
    device performance data fields column definitions (table) 108
    device port performance data fields column definitions (table) 109
    sample of regions (illustrated) 97
display
  commands 90
  screens 92
general description 89
help command 91
host port
  configuration 110
host screen
  sample (illustrated) 99
host status screen
  Fibre Channel known host connections (table) 110
  Fibre Channel link error counters (table) 111
  Fibre Channel port status (table) 110
key sequences and commands (table) 90
remote screen
  column definitions (table) 113
remote screen, sample (illustrated) 102
resource performance statistics 117
resource screen
  resource performance statistics definitions (table) 117
resource screen, sample (illustrated) 101
restrictions, use 89
running VTDPY 89
screens
  interpreting screen information 102
  screen header 103
status screen
  common data fields definitions
    part 1 (table) 104
    part 2 (table) 105
  controller and processor utilization definitions (table) 115
  sample (illustrated) 94
  unit performance data fields definitions (table) 106
thread descriptions (table) 116
unit performance data fields 105

W

warning
  rack stability 17
  symbols on equipment 16
websites
  HP storage 18
write capability
  test for disk devices 121
write requests. See also read requests.
  improving the subsystem response time with writeback caching 45
  placing data with write-through caching 45
writeback caching
  enabling mirrored mode 53
  fault-tolerance, general description 45
  general description 45
  nonvolatile memory 46
write-through caching, general description 45